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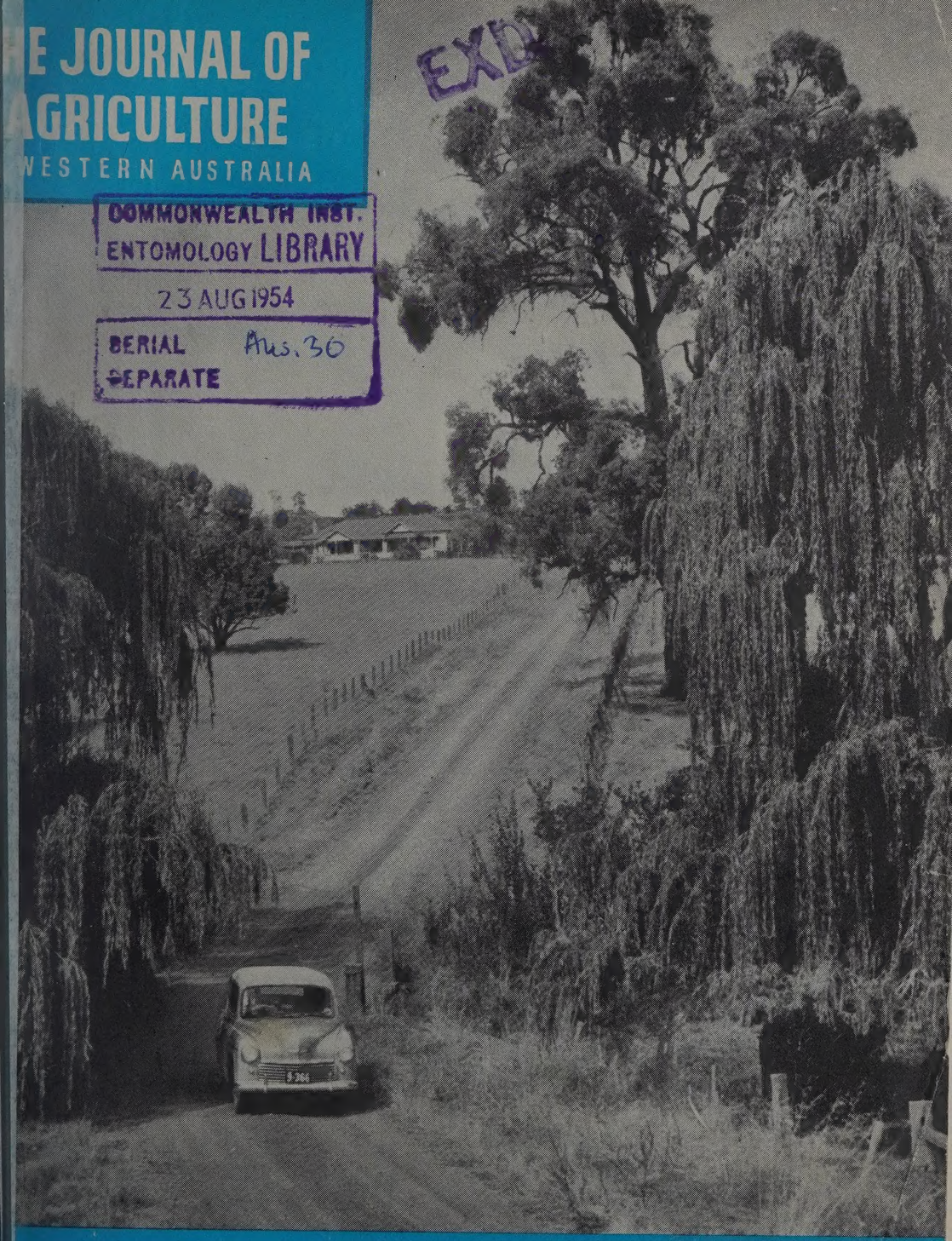

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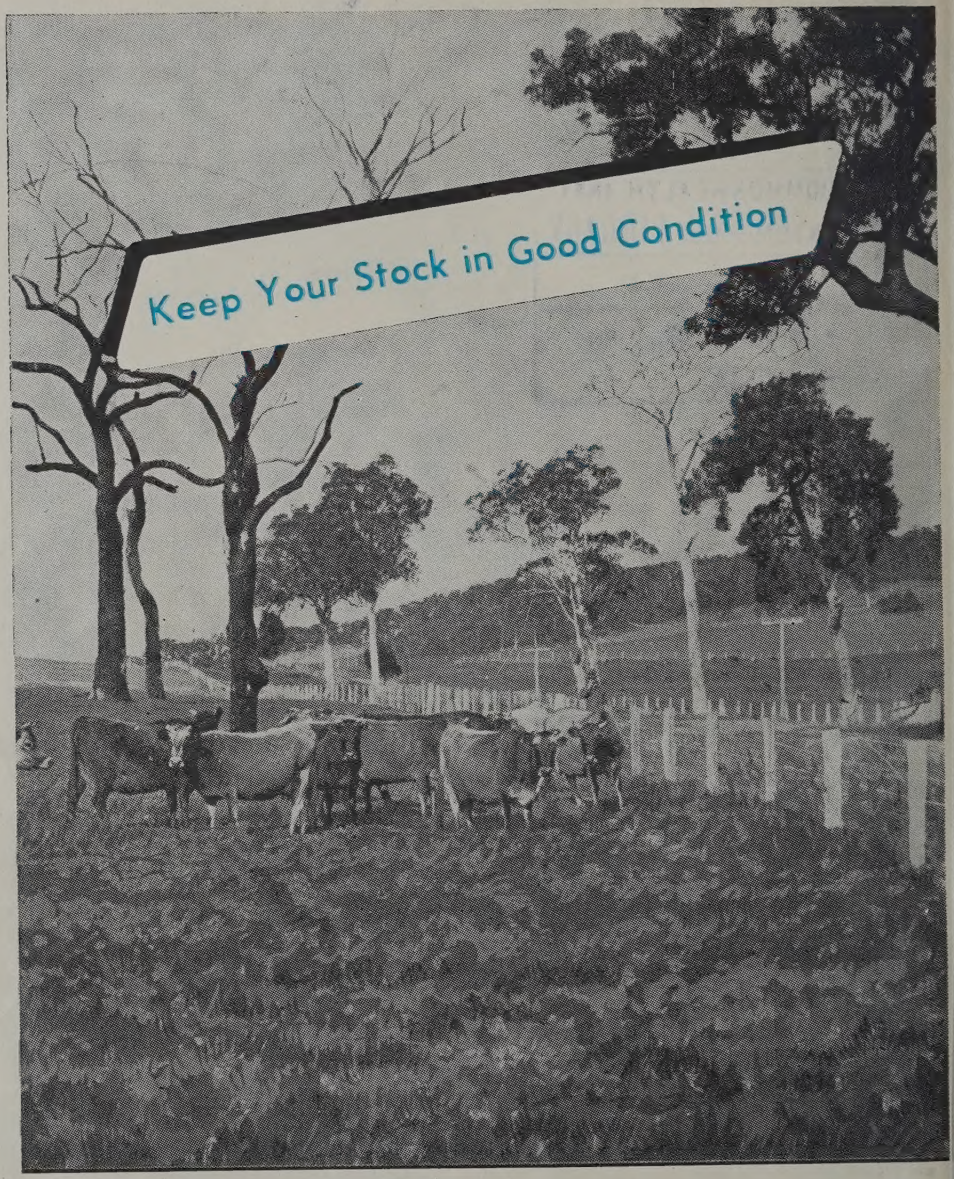

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COVER PICTURE

An attractive rural scene at the aptly-named "Willow Glen" near Bridgetown.

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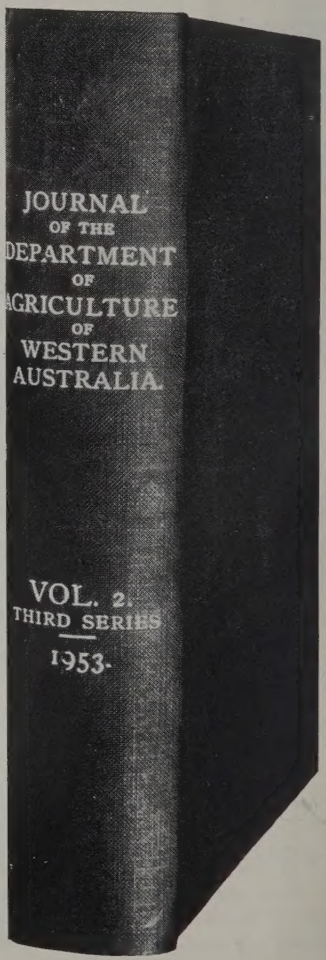


His Excellency the Governor (Sir Charles Gairdner) (left) handing over the "Governor's Cup" to the Principal of Muresk Agricultural College (Mr. W. Southern). This trophy was awarded to the College for gaining the highest number of points in the livestock section at the 1953 Perth Royal Show.

MURESK AGRICULTURAL COLLEGE

Diploma and Prize Presentations

THE Northam Town Hall was packed to capacity on the evening of 8th April, when His Excellency the Governor of Western Australia (Sir Charles Gairdner) presented diplomas and prizes to successful students and also handed over the Governor's Cup which had been awarded to the College as the most successful exhibitor in the livestock sections at the Perth Royal Show.

The Director of Agriculture (Mr. G. K. Baron Hay) was in the chair and welcomed His Excellency and the Hon. Lady Gairdner, the President of the Royal Agricultural Society (Mr. H. N. Higham), the wives of the Premier and the Minister for Agriculture and other distinguished visitors.

In his introductory address, Mr. Baron Hay said that the current year had witnessed a definite change in the agricultural outlook with the advent of a buyer's market for many lines of farm produce. For several years farmers had enjoyed a seller's market with good prices available for practically everything that they could produce.

With narrowed profit margins and keen overseas competition in the export fields, an even greater need now existed for trained men both as practical farmers and as extension officers of the Department of Agriculture. Increased agricultural efficiency could offset the lower returns to a large extent, and Muresk had an important role to play in achieving this.

His Excellency the Governor said that young men of today were particularly fortunate in being able to attend agricultural colleges. As a farmer, he had been compelled to depend upon a correspondence course for much of his own agricultural knowledge and although he completed the course with marked success he soon found that he had to acquire experience "the hard way."

The modern farmer needed to be more than a jack of all trades, said the Governor. To be really successful he had to be a master of many trades, but farming could be a richly satisfying way of life.

In presenting his report on the activities of the College during 1953, the Principal (Mr. W. Southern) said that during the year he had taken accumulated long service leave and with Mrs. Southern he had visited the United Kingdom and several European countries. The trip had been particularly valuable as he had been able to extend his knowledge of agriculture and agricultural education.

Mr. Southern paid a tribute to the work of the Assistant Principal (Mr. A. J. T. Marshall) and the Factory Superintendent (Mr. H. M. Lister) who with other members of the staff had shouldered extra burdens during his absence.

The College had reopened with a full complement of students but he regretted the absence of dairy factory students and said that the butter and cheese industry is apparently a section of the community which obviously denies the necessity for its operatives to be trained.

THE REDESIGNED COURSE

In the past, said Mr. Southern, the Muresk Diploma Course had usually called for a three-year period at the College. The first year had been to a great extent a preparation for the following two years of agricultural education and it had always been possible for students with suitable educational backgrounds to be exempted from this first year of schooling.

The course had now been re-designed and this exemption was made compulsory. Applicants chosen at the end of their Junior Certificate year, proceeded to a further year of study at the school of their choice before entering Muresk. The change had been greatly facilitated by the fact that many Government schools are now proceeding to a higher standard than the Junior Certificate and furthermore, the Education Department had arranged for a special class to be conducted at the Northam High School in order to cater for those who could not take the extra year elsewhere. The co-operation of that Department was greatly appreciated.

Mr. Southern said that the change had several advantages. In the first place the number of students who could avail themselves of Muresk facilities had been increased by 50 per cent. without enlarging the College. The wastage at the end of the old first year term had been eliminated, and students were a year older before they were finally called upon to make up their minds as to their choice of career. Those who wished to complete their Leaving Certificate instead of entering Muresk could do so without much difficulty as their original course had not been greatly interfered with. Some might even choose to complete their Leaving Certificates before entering Muresk.

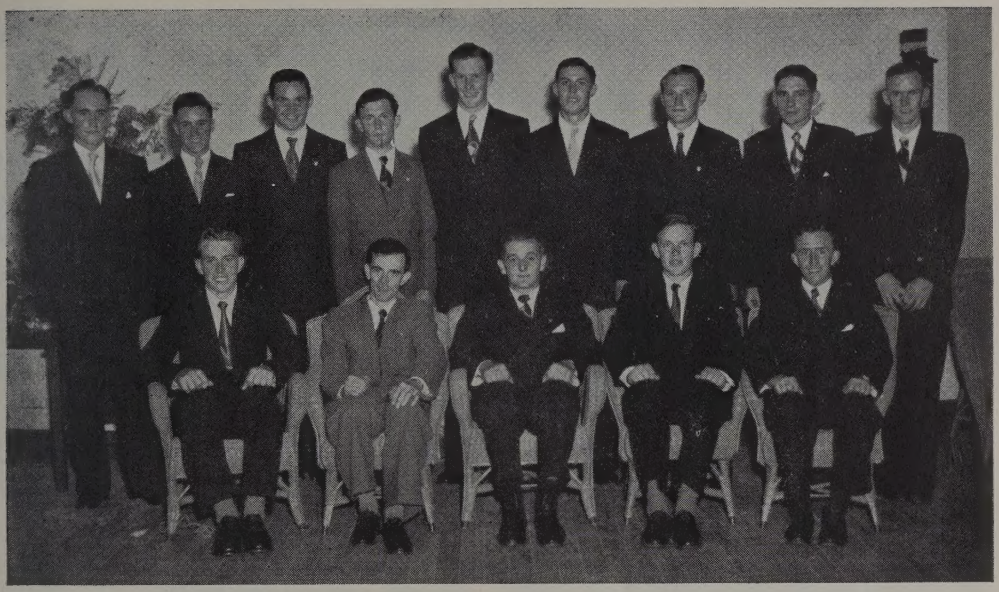
In addition, any who wished to proceed to the University after graduating from Muresk would find the first year of the University course much easier.

Mr. Southern pointed out that despite the reduction from three years to two years at Muresk the actual course itself remained unchanged.

SHOW SUCCESSES

The College had a very successful year at the agricultural shows. At Northam numerous awards were gained including the Rural and Industries Bank Cup.

At the Royal Show, Muresk achieved the proud distinction of winning the Governor's Cup for the second time. In 1934, when the cup was awarded to the highest points winner in a specified section, Muresk had been successful with dairy cattle. Last year's success was due to pigs and cattle, the points gained in each section being 34 and 32 respectively. The Herdsmans Trophy went to Mr. W. Bridle, the dairy instructor, and high praise was bestowed on him and his student team.



Students who received the 1953 Muresk Diploma of Agriculture.
Back Row: G. R. Davies; G. L. Salom; L. E. Douglas; P. L. Squire; G. F. Walder; V. E. Gartner; J. M. Lowe; K. Wise; C. S. Maughan.
Front Row: C. P. Dring; L. F. McKay; D. G. Chappell; A. R. Newnham; B. N. Taylor.
Absent: N. E. Macintyre; J. F. Rucks; N. H. Ansell.

His Excellency the Governor presented the following awards:—

SCHOLASTIC PRIZES, 1954

Diplomas in Agriculture

With Honours—

Allan Richard Newnham.
Lennard Fortescue McKay.
Charles Peter Dring.
Brian Norman Taylor.
Neville Ellis Macintyre.

Major Pass—

Keith Wise.
Neil Henry Ansell.
Graham Ross Davies.
Peter Leonard Squire.
Gordon Llewellyn Salom
David Graham Chappell.
Lawrence Enoch Douglas.
Vincent Edward Gartner.
Christopher Stanley Maughan.
George Francis Walder.

Minor Pass—

John Frieee Rucks.
John Mansfield Lowe.

Final Year Awards

Dux; the H. J. Hughes Memorial Medal (presented by Mrs. Hughes and her family); the Sheep Husbandry Prize (presented by the Wool Brokers Association); and Technical College Woolclassing Certificate—A. R. Newnham.

Second Highest Aggregate and Equal First Practical Activities Prize—L. F. McKay.

Third Highest Aggregate, also Animal Husbandry and Veterinary Science Prizes (both presented by the Livestock Salesmen's Association)—C. P. Dring.

Woolclassing Prize (presented by the Wool Brokers' Association) and Technical College Woolclassing Certificate—K. Wise.

Most Useful Student of his year—J. M. Lowe.
Practical Activities Prize—equal first—N. E. Macintyre.
Technical College Woolclassing Certificates—N. H. Ansell, G. R. Davies and G. L. Salom.

Second Year Awards.

Dux (tie); Medal presented by Mr T. H. Wilding: Outdoor Activities Prize and Animal Husbandry Prize (presented by the Livestock Salesmen's Association)—G. T. Jones.

Dux (tie); Medal presented by Mr. T. H. Wilding; Prize for Most Improved Student; and Veterinary Science Prize (presented by the Livestock Salesmen's Association)—R. R. Fraser.

Third Highest Aggregate, and Prize for Most Useful Student in his year (tie)—R. A. Eiverr.

Woolclassing and Sheep Husbandry Prize (presented by the Woolbrokers' Association)—E. R. Jacobs.

Most Useful Student in his year (tie)—N. W. O'Garr.

First Year Awards

Dux; Medal presented by the Principal—M. E. Nairn.
Second Highest Aggregate (tie)—D. M. Warne.
Second Highest Aggregate (tie)—M. E. Vivian.
Fourth Highest Aggregate—L. J. Chapman.
Woolclassing Prize—F. E. Pauley.
Outdoor Activities Prize—L. P. Strugnell.
Most Useful Student of his year—J. M. Wallis.

Special Prizes

Best Contribution to College Magazine—D. R. Foley.

Outdoor Activities over the last two years: Perpetual Cup, and Annual Prize presented by the Northam Agricultural Society (these trophies are in recognition of the work done by students at the Northam Show)—L. F. McKay.

Botany Collection Prizes

First Prize (presented by Mr. J. Walker)—R. J. Grieves.

Second Prize—G. D. B. McGuire.

Third Prize—E. Hewett.

Scholarships

Department of Agriculture Scholarship—M. C. Tiller.

"The Western Mail" Scholarship—D. R. Foley.

The J. J. Poynton Memorial Scholarship (tie)—J. H. Brockman and L. J. Chapman.

Best All-round Student during his course (prize presented by Mr. W. K. Stott)—B. N. Taylor.

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Athletics: Runner-up
Football: Fairest and Best — G. T. Jones.

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Football: Fairest and Best—Runner-up — V. E. Gartner.

Tennis: Runner-up Singles Champion
Athletics: T. V. Waters Memorial Shield — D. P. Morcombe.

Tennis: Singles Champion—D. Home.
Swimming: Champion—R. Campbell.
Swimming: Runner-up—N. E. MacIntyre.

Tennis: Junior Champion
Hockey: Most Improved Player — R. Fraser.

Tennis: Junior Doubles Champion—L. E. Douglas.
Football: Most Improved Player—G. Carslake.
Hockey: Fairest and Best—G. Salom.
Hockey: Runner-up—Fairest and Best—M. Gerber.
Basketball: Fairest and Best—C. P. Dring.
Shooting: Champion Shot—E. R. Jacobs.

Tennis: Junior Doubles Champion
Athletics: Junior Champion — M. E. Nairn.

Athletics: Runner-up Junior Champion—R. Grieves.
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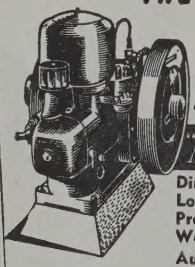

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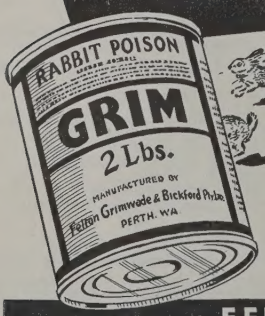

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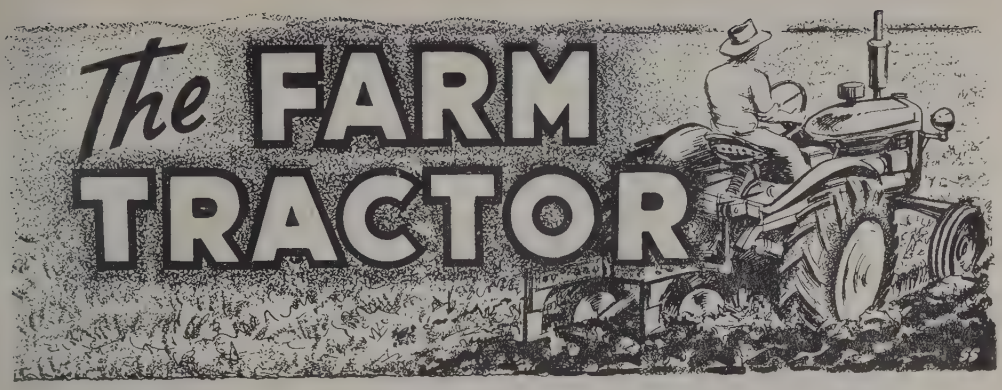


Part 2.—Tractor Types, and Some Hints on Using Them

THE most common type of tractor in this country is the medium-sized four-wheeled general purpose machine, which may have either pneumatic-tyred or all-steel wheels.

The power which a tractor is capable of giving at the drawbar must be transmitted through the rear wheels. No matter how good its engine may be, a tractor will be useless for farm work unless the rear wheels can grip on agricultural land, which is often loose or wet. The steel driving wheels of a tractor are therefore fitted with lugs or strakes, which bite into the soil as the wheels revolve. For the same reason, if the driving wheels are fitted with pneumatic tyres these have a deep tread and are worked at a very low pressure (12 lb. per square inch). The front wheels of a steel-wheeled tractor are provided with flanges which cut into the soil and assist steering. Pneumatic-tyred front wheels generally have treads consisting of one or more ribs running right round the the tyre, but these are less effective than the metal flange, and pneumatic-tyred tractors are sometimes awkward to steer on wet surfaces.

Rowcrop.—Rowcrop tractors are specially intended for use with potatoes, sugar beet and other root crops, which are planted in rows and need to be hoed or cultivated for some time after they have grown above ground. The details in which rowcrop tractors differ from general purpose ones are as follows:—

1. The wheels (either steel or pneumatic-tyred) are narrow enough to go between the rows without damaging the plants.

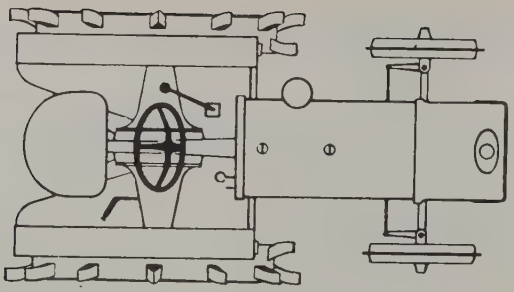
2. The wheels are adjustable on their axles for track width so that they can be made to fit rows of different widths (rows of potatoes, for example, are much wider apart than rows of sugar-beet).

3. The tractor as a whole is high enough off the ground to pass over crops, such as brussels sprouts, in a fairly advanced stage of growth.

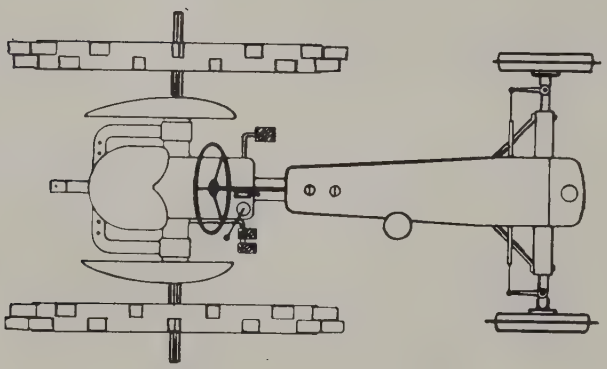
4. Rowcrop tractors can generally make sharper turns than an ordinary tractor so that headlands in the field can be narrower. This is often achieved by fitting independent brakes on the rear wheels. By braking the inside rear wheel, the tractor can be made to turn short on that wheel.

These differences do not, of course, prevent rowcrop tractors from doing ploughing and cultivating. Some rowcrop tractors have only a single wheel at the front, or two wheels so close together as to behave practically as a single wheel. This feature makes it still easier for the tractor to turn sharply, and avoids the extra complication of adjusting the spacing of the front wheels to fit different row widths. Three-wheeled tractors are, however, less convenient for general farm work.

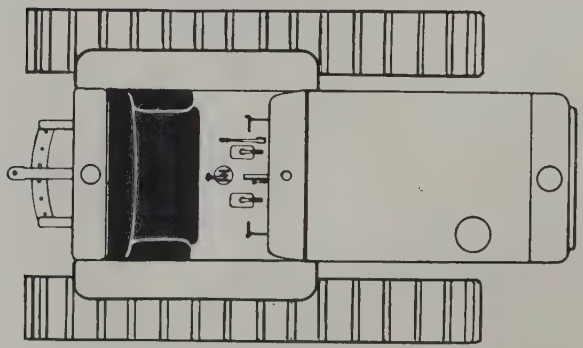
There is a tendency in later tractor models to combine some of the rowcrop and general purpose characteristics in the same tractor. This gives a general purpose tractor with fairly high clearance, adjustable wheels and independent brakes on the



GENERAL PURPOSE



ROW CROP



TRACKLAYING

FIG. 14 TRACTOR TYPES

rear wheels. Such a type may be found to be of more use on a farm where the acreage only warrants the use of a single tractor.

Tracklaying.—The third type of tractor is the "tracklaying" or "crawler" machine on which the land wheels are replaced by an endless flexible track. These machines behave as if they were running, not on the surface of the soil, but on steel rails which they pick up and re-lay in front of themselves as they travel along. They have two very real advantages: they get a much better grip, especially on loose surfaces, than any other type; and, because of the very large area of contact between the tracks and the ground, they do not compress the soil to the same extent as a wheeled tractor of similar weight. They are not very common, however, because they are relatively expensive both to buy and to maintain, although from an engineering point of view they are more efficient than wheeled tractors. Most of the tracklayers used are relatively powerful machines—in fact, a really powerful tractor is almost bound to be fitted with tracks because there is a limit to the pull which a pair of wheels of ordinary size can transmit.

STEEL AND PNEUMATIC-TYRED WHEELS

In designing driving wheels to transmit the heavy pulls required from an agricultural tractor, engineers are facing two difficulties. If, as in the case of steel wheels, the rim is fitted with deep lugs or strakes, the grip is efficient but an appreciable proportion of the total power output of the engine is liable to be wasted in pushing the lugs into the soil. This loss of power is generally called rolling resistance, and is roughly proportional to the speed at which the tractor is travelling. A steel-wheeled tractor cannot be geared to work at a very high speed because it would use up all the power of the engine in getting itself along and have none to spare for pulling an implement.

If, on the other hand, the wheel has a relatively smooth surface, as is the case with pneumatic tyres, the rolling resistance loss is smaller but power is liable to be lost in wheel slip. Everyone knows what wheel "spin" is—for example, when the rear wheels of a motor car spin round on mud or some other slippery surface so that the car comes to a standstill. Wheel "slip" is the same sort of thing in a less acute form: the car or tractor does not come to a complete standstill, but it travels forward a much shorter distance than it ought for each revolution of its driving wheels. In such a case the wheels may be turning five times in order to move the tractor 50 feet along the ground, when if there were no wheel slip four times would do. This leads to:—

1. Waste of fuel.
2. Loss of power at the drawbar.
3. Excessive wear on rubber tyres.

Steel wheels are more suitable for slow, heavy work like ploughing and cultivating, while pneumatics are better for light work like harrowing, manure distributing, or haymaking, which can generally be done at higher speeds. Alternatively, when the same tractor can be fitted with either steel or pneumatic-tyred wheels, it should be worked mainly in the lower gears when fitted with the former and in the higher gears when fitted with the latter. Pneumatic tyres are especially suitable for haulage, and they are almost essential if the tractor is to be used for this work on public roads. Steel-wheeled tractors cannot travel on the roads at all, until they have been fitted with road bands or some similar device for preventing damage to the road surface, and the road bands must be removed again before the tractor can work efficiently in the field. In addition, the grip of road bands is not good enough to allow the tractor to pull any appreciable load on road surfaces.

While on this subject it is worth noting that although tracklaying tractors are highly efficient as regards both rolling resistance and wheel slip, they should always be worked in the lowest possible gear. This is because of track wear which increases more or less in proportion to the speed of travel. Track wear is the most expensive item among maintenance costs, and on sandy or "cutting" soils it may be so great that it is not economic to use a crawler tractor at all. Large implements are necessary to use the full power of a crawler in a low gear.

TRACTOR POWER OR CAPACITY

In some of the preceding paragraphs, such terms as "medium-powered," "relatively low-powered," and so on have been used without explanation. The engineer's measure of a tractor's capacity is its drawbar horsepower. But this "horse-power" bears no relation to the work a horse can do on a farm, i.e., one cannot assume that a ten-horsepower tractor will do the work of ten horses. And so, although a farmer will recognise that a tractor of 15 h.p. is fifty per cent. more powerful than one of 10 h.p. he will probably not know how much to expect from either of them in a day's work when pulling, say, a plough or a cultivator. For this reason another kind of measure is commonly adopted for use on the farm. Instead of specifying the horsepower we sometimes specify how many furrows the tractor should plough at once. This measure is inexact, because the pull required by a given plough will vary with soil, working conditions and the speed of work. Some standards have to be fixed; these are:

1. Speed.—Most ploughing is done at about 3 m.p.h., so this figure is taken.

2. Land.—This is given as "average land." That is land which needs two good or three moderate horses on a single furrow plough at normal width and depth of furrow.

Under these conditions each furrow ploughed needs about 5 h.p. so that—

A 5 h.p. tractor should pull one furrow on average land.

A 10 h.p. tractor should pull two furrows on average land, and one medium-sized tractor of about 15 h.p. should pull three furrows on average land.

When the number of furrows that a tractor should pull is known, the correct widths of other implements can be estimated.

For each 10-inch furrow, a tractor should pull:

Three times the furrow width of cultivator or disc harrow, i.e., 2 ft. 6 in.

Six times the furrow width of heavy harrow, i.e., 5ft.

Five times the furrow width of drill or binder, etc., i.e., about 4 ft.

Thus a 3-plough tractor will handle a 7 ft. 6 in. cultivator or disc harrow, 15 ft. of heavy harrow, 12 ft. of drill or two 6 ft. binders, etc. This gives only an indication; the tractor may pull a bigger implement in easier conditions, and may need a smaller implement in more difficult conditions.

TRACTOR LOADING

In the interests of economy it is important that tractors should be fully loaded. But they should not be overloaded, so that the engine speed is greatly reduced.

There are three ways of adjusting the load to give economical working:—

1. The setting of the implement. Ploughs may be set for wider furrows or have another furrow added, if the load is insufficient. A cultivator may have the two outside tines removed if the tractor is overloaded.

2. Hitching implements together. Seed harrows may be coupled behind a drill—a roller behind disc harrows, etc.

3. Using a higher gear. Light harrows or a drill may be a load in second gear and not in first. It is more economical for a tractor, with the same implement, to work throttled down in second gear than at full throttle in bottom gear.

TRACTOR OPERATION

As a first step in driving a tractor, the operator should familiarise himself with the controls. These are:—

Engine Controls

(a) **Throttle or Governor Lever.**—As has been explained, the control of the throttle is effected through a governor and not, as in the case of a motor car, directly by the operator. The governor control lever is always hand-operated. It does not require continual adjustment during work since the governor automatically controls the engine's response to varying loads.

(b) **Ignition Control.**—There may be an advance-retard lever and an ignition switch. In some makes of tractor these are combined. Some tractors are not fitted with any advance-retard control, but there is always some way of switching off the ignition.

(c) **Choke.**—There will be some method of choking the engine for starting. Very often this is only a piece of wire attached to the choke, and it may be found by the steering wheel or at the front of the tractor near the starting handle.

Transmission Controls

(a) **Clutch.**—The clutch may be foot or hand-operated: sometimes both types are fitted to the same tractor. On most track-laying machines there are, in addition to the transmission clutch, separate clutches in the final drive to each track. These are hand-operated.

(b) **Gear-box.**—A tractor is not started like a car, by working through the gear-box from bottom to top gear, but is driven off in the gear to be used. Similarly, if the gear is to be changed, the tractor must be brought to rest before making the change. It is very dangerous to try to start the engine without making sure that the tractor is not in gear. The operator should be certain that he knows from the feel of the gear lever when it is in the neutral position and see that it is there before attempting to start the engine.

(c) **Brakes.**—There are various arrangements made for braking different tractors. Some tractors are fitted with independent brakes on the two driving wheels to assist in turning quickly. Tracklaying machines have independent, foot-operated brakes for the two tracks, and these also are used for turning.

STARTING THE ENGINE

First see that the gear lever is disengaged and in the neutral position.

The engine must be started on petrol: see that the vapourising oil tap is closed, and the petrol tap open, or if the tractor is fitted with a two-way fuel tap, see that it is in the petrol position. Make sure that there is some petrol in the petrol tank. See that the radiator blind is pulled up as far as it will go to cover most of the radiator.

Now switch off the ignition, and retard the spark. Many tractors have a combined switch and spark control lever: set this in the "off" position.

Pull the governor control lever one-third out.

On models not fitted with self-starters, pull the choke right out and give four sharp upward pulls to the starting handle. This primes the engine ready for starting. The starting handle should always be pulled up. To avoid possible injury from back-firing get into the habit of cranking with the thumb on the same side of the handle as the fingers.

After priming the engine, open the choke a little, and switch on the ignition, leaving the spark fully retarded. A sharp pull on the starting handle should now start the engine. The engine may take two or three pulls before it fires. Do not re-prime it by pulling out the choke again, unless it is certain that it was not primed properly the first time, since an overchoked engine must be turned over several times to pump out the excess fuel before it will fire. After starting, if the engine is very cold it may need choking slightly until the vapouriser is warmed. Push the choke in as soon as the engine begins to "take hold."

MOVING OFF

Depress the clutch pedal right down and move the gear lever from neutral into the gear which is to be used. In some tractors it may be difficult to get the gear to go in at the first attempt. If this is so, re-engage the clutch, then depress the pedal and try again. Should this also fail, keep the clutch pedal down, hold the gear lever firmly in the direction you wish it to go to engage the selected gear, and very gradually release the clutch. If this is done very slowly the gear will slip in easily. When in gear, advance the ignition to the working position, and open the governor lever until the engine is running at working speed. Now ease in the clutch, allowing the engine to take the load gradually. When the clutch is fully engaged remove your foot from the pedal entirely as "clutch riding" wears out the clutch thrust mechanism.

If the clutch is let in suddenly, there is a big shock on the transmission, a danger of stopping the engine, and where the load is heavy, a danger of causing the tractor to rear up, raising the front wheels off the ground. Should this occur, "throw" the clutch at once and the front will return to the ground. This is most likely to occur with a very heavy load, when the rear of

the tractor is in a hollow or furrow, or when the tractor is facing up a hill, and great care should be exercised in moving off from such positions.

Once the tractor moves off, the governor will control the engine, maintaining an even speed although the load may fluctuate.

STEERING

Steering a wheeled tractor calls for no comment, since it is exactly the same as steering a car or lorry. A tracklaying tractor, however, cannot be steered in the same way as one with wheels; one of the tracks must be declutched or braked so that the other one pushes the tractor round. Instead of a steering column and wheel it will have a lever and a pedal on each side, so that when the left hand lever is pulled, and the pedal depressed, the tractor will turn to the left, and vice versa. It follows that a tracklaying tractor can turn in its own length by spinning round on one track. This is to be avoided as a general practice, and used only in an emergency, owing to the unnecessary strain thus imposed upon the tracks. In turning a tracklayer in ordinary work, the inside track should be kept moving.

SUBSEQUENT OPERATION

Radiator Temperature

If there is a radiator thermometer or temperature indicator, watch it during the first five minutes after starting. When it indicates about 190°F., or the pointer is in the green section of the scale, change over to vapourising oil by first closing the petrol tap, and then opening the vapourising oil tap, or by changing the tap over if the tractor is fitted with a two-way tap. The radiator blind must be partially lowered, covering only so much of the radiator as will serve to prevent the temperature from falling below 190°F. or the indicator from pointing to the "cold" section of the scale. If the tractor has no temperature indicator or thermometer, plough the first bout on petrol, or run the engine for at least five minutes on petrol before changing to vapourising oil. When first on vapourising oil leave the blind fully up until the engine just boils. This will be indicated by a wisp of steam coming from the radiator.

The blind should now be lowered a few inches. If steam appears again repeat the lowering of the blind until a point is found where steam ceases to show at the bottom of the radiator. Then the water temperature will be maintained just below boiling, and should be kept as near this temperature as possible during all work. No great harm is done if the water boils, so long as the radiator does not boil dry, but considerable damage can be done by keeping the engine too cool. This allows unvapourised fuel to reach the cylinders and so go past the pistons to the sump where it dilutes the oil and destroys in great part its lubricating qualities. Should the engine inadvertently be allowed to boil dry, do not add fresh water until the back of the hand can be comfortably applied to the cylinder head, otherwise there is a danger of cracking the cylinder block by sudden cooling.

If the engine is stopped for any reason during work and stands for longer than a minute or two, it must be restarted on petrol, as the vapouriser soon becomes too cool to vapourise the heavier fuel. If the weather has been cold, try, during the last hour of each day's work, to bring the radiator water almost to the boil by raising the blind. This will evaporate unwanted fuel from the lubricating oil and preserve its quality.

Jet Setting

Where a variable jet is fitted to the carburettor on a tractor engine it is of the utmost importance to see that it is correctly set. With an incorrectly set jet a tractor may use nearly double the normal quantity of fuel in a day without doing any more work. Therefore the jet should be set as follows:—

1. Put the tractor in work, e.g., ploughing.

2. As the tractor is working screw the needle down gradually until the engine begins to falter and lose power.

3. Open the jet $\frac{1}{8}$ to $\frac{1}{4}$ of a turn.

This setting should be checked on a number of jobs to ensure the maximum fuel economy for varying loads.

Stopping the Tractor

Throttle the engine down to about half speed and retard the spark. Put the clutch out, move the gear lever to the neutral

position, and let the clutch back. If the tractor is on pneumatics and rolls forward, apply the brake, or anchor the clutch pedal down.

Turn on to petrol for a minute or two before stopping the engine. Finally switch off the ignition and put the tap in the closed position.

On no account must the engine be allowed to stop with vapourising oil in the vapouriser, as it will prove very difficult to start after it has cooled off. Should this be allowed to happen, the float chamber must be drained through the drain cock at the bottom, before the petrol is turned on.

Note that if the vapourising oil tap is opened while the petrol tap is open, some vapourising oil will find its way into the petrol tank and mix with the petrol, rendering starting difficult, so be careful to see that both taps are never open together.

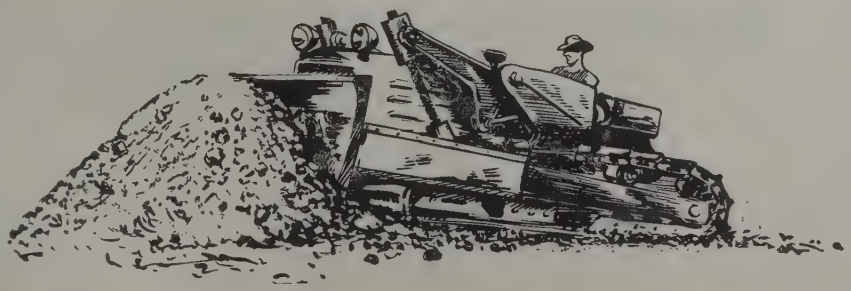
Coupling the Tractor to an Implement

The tractor must be reversed back to the implement until the jaws of the implement hitch fit over the drawbar plate, and the clevis pin pushed into place, locking the two together. The operation of backing the tractor on to an implement calls for a considerable degree of care. This operation has been the cause of many accidents. Halt the tractor 18 inches or so from the implement and throttle the engine right down so that it is just ticking over. Now ease the clutch in very carefully so that the tractor moves back on the implement very slowly. On no account take the foot off the clutch pedal, and be ready at all times to "throw" the clutch at once

When coupling to an implement with a rigid drawbar a helper is generally needed. He should hold the drawbar so that as the tractor backs, the tractor hitch-plate enters the jaws of the drawbar clamp. The helper should stand in such a position that he can readily get out of the way if something goes wrong. He must certainly not get on his hands and knees, for example, to see better what is happening. If the clevis pin is held in position on the top of the drawbar clamp, it can be pushed down as soon as the holes come into line and thus secure the tractor. It is often difficult to hold the tractor in exactly the right position because when the clutch is "thrown" the tractor rolls forward an inch or so. With a plough the drawbar can often be brought into alignment by moving the hitch control lever, or by pushing on the land wheel of the plough to move it forward slightly.

When coupling to an implement with a flexible chain hitch there is no trouble: just put the tractor near enough to the implement to come within the range of the hitch and pin the clamp to the drawbar plate.

(To be Continued)



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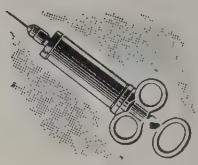

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Fig. 1.—Cattle at Button's Crossing on the Ord River stock route

AGRICULTURAL EXTENSION IN THE NORTH-WEST AND KIMBERLEY REGIONS

By W. M. NUNN, B.Sc. (Agric.), Officer in Charge, North-West Branch

SHORTLY after the depression of 1929 and the early "thirties" I found myself in the north-eastern wheatbelt, employed as Agricultural Adviser in the Wheat Branch and charged with the responsibility of taking scientific agriculture to the farmers of those parts. The best farmers were struggling hard to stay on their properties; the majority were fighting losing battles and were not overpleased with the Government of the day or with any of its representatives.

As a comparatively raw graduate of the Faculty of Agriculture, I frequently found it hard to convince a client that he had any use for me or that an agricultural extension service could be in any way helpful to the man on the land.

Things have changed a good deal since those days. The farmer is something of a scientist himself, and the agricultural extension worker is very much in demand.

In the pastoral regions an extension service is very much more difficult to provide. Population is scattered, transport is difficult, and people cannot easily be brought together. For these same reasons, an extension service is all the more necessary because the station people have but little opportunity of meeting each other and profiting by each other's experiences.

Fig. 2.—Dust-clouds rise as a mob of cattle approach Button's Crossing near the Kimberley Research Station

The North-West Branch was inaugurated a few years ago for the purpose of co-ordinating formerly isolated Departmental projects in our North, and of developing a sound agricultural approach to the requirements of this country.

It is a country which abounds with problems; problems which are difficult to solve; difficult even to define; and difficult to place in order of importance.

RESEARCH IN THE KIMBERLEYS

For this reason, research and extension must go hand in hand so that science and practical experience may be brought together as frequently and as intimately as possible.

In East Kimberley we have the Kimberley Research Station. Here the research programme is shared with the Commonwealth Scientific and Industrial Research Organization, and is primarily

Fig. 3.—Cutting and weighing sugar cane on the Kimberley Research Station, Ord River

Fig. 4.—An experimental plot of rice at the Kimberley Research Station. To protect the crop from birds, the plot is grown in a wire-netting enclosure

directed toward the possibility of establishing an irrigation settlement on the Ord River. Agricultural Adviser Fitzgerald has had headquarters at this station and has taken a good deal of information on irrigation practices to stations throughout the Kimberleys. His contribution can be seen to best effect in the West Kimberley where a number of stations with sources of irrigation water have been able to profit considerably from the service he has provided. Mr. Fitzgerald has accepted an appointment with the Northern Territory Administration. He will be greatly missed by those who knew him in Kimberley, but I hasten to advise them that another officer will be along to continue the good work.

In West Kimberley, Cattle Adviser Grant Smith is working hard to obtain reliable grazing figures for cattle under range conditions, and to demonstrate the economics of mineral supplements. It's a hard battle for one seeking to improve the cattle industry, because thousands of miles of fencing is required to enable reasonable control of stocking, and at £150 per mile this takes the project rather beyond the scope and means of the agricultural worker.

TROPICAL AGRICULTURE

At Carnarvon, the Gascoyne Research Station has been, until recently, concerned with tropical fruit culture. Agrostologist Dr. B. Rumich has now made it his No. 1 Plant Introduction Centre, and we feel it will play an important part in future as a testing ground for introduced species which may have an important bearing on pastoral area carrying capacity.

For years there has been talk of lucerne as a commercial crop for the Carnarvon plantation area. There is certainly a de-

mand for it in the North, and it enjoys some advantage over bananas and beans in the way of lower water and labour requirements. Largely as a result of Dr. Rumich's advice and encouragement, we now have a group of interested growers and no doubts at all as to their future success.

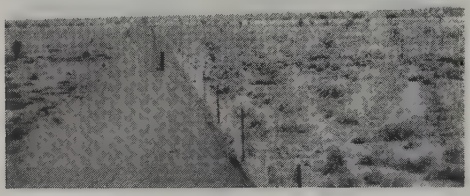

Fig. 5.—Spinifex management trials at Woodstock Station in the Port Hedland hinterland. The area is fenced against kangaroos

IN THE SPINIFEX COUNTRY

The Government-owned stations Abydos and Woodstock, 100 miles inland from Port Hedland, are now the centre for a combined attack on vermin problems. The Agricultural Protection Board, the Commonwealth Scientific and Industrial Research Organization and the North-West Branch are pooling resources in an endeavour to throw some light on the dingo and kangaroo menace.

Between the 1952 and 1953 shearings, sheep numbers on 22 stations decreased by a total of 30,000. Of these losses an unknown proportion would be due to direct killings by dogs. For the balance we can blame the kangaroo because he has eaten out the country to the extent that low lambing percentages and high lamb mortality are quite unavoidable, even on the best-managed stations.

Spectacular results are not to be expected in this field but there is no doubt that vermin present a very serious problem in the management of this country, and a concentrated effort by all concerned is urgently warranted.

Working from the same centre, Agricultural Adviser Suijdendorp has embarked on one of the most difficult lines of investigation—the management of spinifex pastures. Having commenced with a botanical study of the area he is already something of an authority on local sheep feeds, and the feeding habits of the animals grazing those areas. Now, with a number of kangaroo-proofed enclosures, he is studying and recording the sheep carrying capacity of spinifex under several different systems of grazing and management. Once again, results will come slowly, but I am convinced that some worthwhile contributions to enlightened station management are on the way.

It is rather a disappointment that at this stage, I am unable to point to an active programme in the mulga zone.

Fig. 6.—An experimental area of spinifex on Abydos Station, Port Hedland district. It is fenced to exclude sheep, but to permit grazing by kangaroos. Soft spinifex in the left foreground is eaten down while woolly spinifex is untouched

Twenty years ago our North-West areas carried five million sheep, which was 50 per cent. of the State's sheep population. Now they carry three million, which is about 25 per cent. of the present population. The increase in agricultural area numbers is principally due to improved pastures and improved methods, and for these the achievements of agricultural research workers are largely responsible. While this has been going on, the pastoral areas have been going backward, and huge areas are threatened with soil erosion as a direct result of uncontrolled overgrazing by both sheep and kangaroos.

A PASTORAL FIELD DAY

Successful Innovation by the North-West Branch

In the more densely-populated areas of the State, the annual field days organised by the Department of Agriculture, have long been a popular form of agricultural education. On April 3, 1954, the North-West Branch staged the first field day to be held on a Departmental property in the purely pastoral areas. The venue was Abydos and Woodstock Stations, two adjoining properties in the spinifex area, 100 miles inland from Port Hedland.

The response to the invitations issued by the Department of Agriculture was particularly gratifying to the organisers of the field day.

Visitors arrived from stations more than 200 miles distant and it is doubtful whether there were more than six stations, within a 200-mile radius of Abydos, that were not represented at the gathering.

A CHEERY GATHERING

It would be difficult for people unacquainted with station life to appreciate the manner in which these men got together to extract the fullest possible instruction and enjoyment from the meeting. They brought food and bedding and settled in with everybody contributing to the real party atmosphere. Some unrolled their swags on the lawn and verandahs while others preferred the gravelly backyard or the sandy bed of the Coorong Creek.

Everybody seemed to be an old friend of everybody else although their individual homes were in most cases hundreds of miles apart and meetings only occurred at long intervals. Christian names were used by all and every visitor was rapidly absorbed into the group.

Departmental officers strove to provide whatever hospitality was possible but beyond lighting the copper fire they had little opportunity of contributing.

Mr. Angus Richardson, part-owner of Pippingarra Station, butcher, businessman and chairman of the Road Board, provided and personally cooked the stew which fed the 30 people present and helped to put the seal of hospitality and goodwill on the proceedings.

Another deserving of special mention was Mr. Rob Lukis, manager of Mundabullangana Station and president of the Port Hedland branch of the Pastoralists Association. He was responsible for much of the local organisation and is a progressive pastoralist who is exerting a valuable influence in the district and arousing enthusiasm in the younger station men.

INTERESTING ITINERARY

It must have been an exciting and satisfying day for Agricultural Adviser Hank Suijdendorp, who has worked toward it during recent seasons of experimentation with spinifex management, and there was abundant evidence that he has made a marked impression on the station people.

Fig. 1.—Visitors inspecting an area from which sheep were excluded but kangaroos could gain admittance. Note the butts of palatable *Plectrachne* severely eaten down in the foreground. The large tussocks are of unpalatable Woolly Spinifex.

Fig. 2.—Mr. Suijdendorp addressing visitors from a 12-acre enclosure on which he hopes to maintain four sheep continuously by rotational grazing.

The morning programme included an address by Mr. W. M. Nunn, Officer-in-Charge of North-West Branch, summarising the objective of the stations, followed by inspections of regeneration plots and buffel introduction plots on Abydos country.

In the afternoon, inspections were made of spinifex management and controlled grazing plots on Woodstock Station, with addresses by Mr. Suijdendorp at each stop.

In the evening, coloured slides depicting the work of the Department of Agriculture throughout the Murchison, North-West and Kimberleys areas were shown and short descriptive talks were given by Messrs. Nunn and Suijdendorp, and by Dr. Rumich, Agrostologist of the North-West Branch. These were followed by an address by Mr. A. M. Stewart, Assistant Director of the University Institute of Agriculture, who was able to make interesting refrences to pastoral experience in U.S.A.

Visitors were deeply impressed by the demonstrations showing the effect of continuous grazing in eliminating the more valuable pasture species and allowing inedible types to monopolise the country. The first plot visited was an area enclosed by a fence which excluded sheep but allowed kangaroos to graze as they wished. Here the grasses and soft spinifex were eaten back to such a degree that seeding had been prevented, while unpalatable wooly spinifex was untouched and seeding prolifically. The only young plants to be found were the inedible ones, and with this demonstration there could be no doubt in the mind of any visitor that continuous grazing, either by sheep or kangaroos, even at low stocking rates must eventually lead to a closed community of inedible types. All agreed that this may explain why stations in the spinifex regions now have much lower carrying capacities than they had twenty or thirty years ago, and why paddocks which then could produce good lambing percentages are not fit only for dry sheep.

SOME SURPRISING RESULTS

With this lesson well in mind the station men displayed the keenest interest in the management trials which set out to determine the carrying capacity of country under grazing methods designed to protect valuable species at susceptible periods, and to encourage their spread, while at the same time making intelligent use of the feed available.

It is far too early in this work to draw definite conclusions from these experiments, but it was apparent to all that grasses not to be seen outside the plots were returning in the plots which were control-grazed, while at the same time the grazing days added up to the astonishing figure of a sheep to two acres on country which popular local opinion would probably assess at about one sheep to 15 or 20 acres under ordinary paddock grazing.

THE KANGAROO MENACE

It becomes more and more obvious that the kangaroo population must be reduced. Then, and only then, will we be able to

Fig. 3.—Visitors inspecting the 8-acre management enclosures on which grazing days averaged better than 200 per animal.

Fig. 4.—The appearance and behaviour of individual plants are regularly recorded on the area and country which the visitors are inspecting. This area is not protected from kangaroos and the only young plants persisting are the inedible or unpalatable ones.

control-graze our country and bring about the conditions necessary to return it to its former productivity.

Visitors were delighted to learn at the field day that arrangements are now well in hand for a team of research workers to commence a study of the kangaroo and methods of controlling the pest, using Woodstock Station as a base for operations. If their efforts are attended by anything like the success obtained by Mr. Suijdendorp in his management trials, then some real improvement is to be expected in the spinifex areas.

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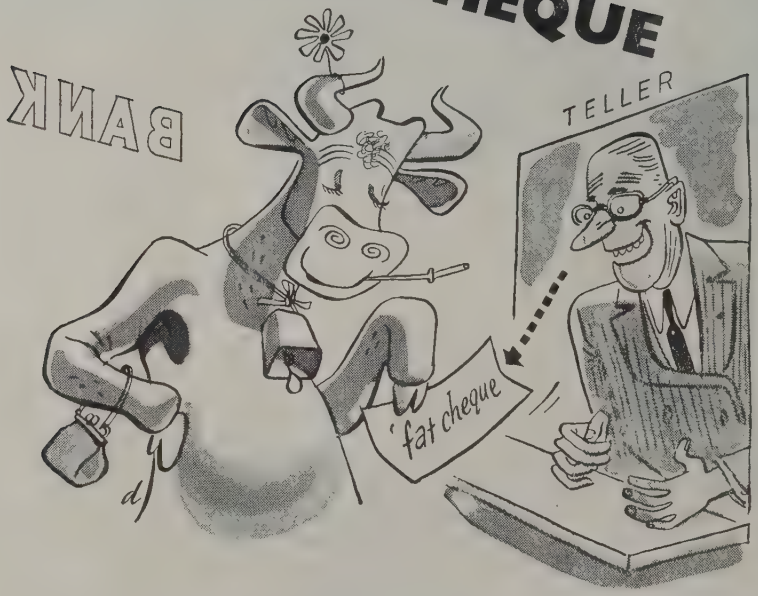

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ONE-LEAFED CAPE TULIP

[*Homeria Breyniana* (L.) Lewis]

Two species, the one depicted above and the Two-leaved Cape Tulip (*H. miniata* Sweet) are perennial weeds of major importance occurring over an extensive area in Western Australia. Besides reducing the carrying capacity and value of land they are poisonous to stock.

WEEDS of Western Australia

By **G.R.W. MEADLY** M. Sc.
Officer in Charge, Weeds and Seeds Branch

CAPE TULIP

(*Homeria Breyniana* (L.) Lewis* and *H. miniata* Sweet)

SOUTH Africa has provided us with a number of undesirable weeds including double-gee, Berkheya thistle, Guildford grass and stinking roger, but outstanding among the weed introductions from that country are two species of Homeria known as Cape Tulip. The salmon-coloured flowers and long grass-like leaves are known to farmers in many localities extending from Geraldton to Albany and as far east as Bruce Rock and Merredin. Beyond the metropolitan area the largest infestations occur in the Northam, York, Beverley and Williams districts where thousands of acres of good land are affected.

Cape Tulip provides one of the many examples of a plant cultivated for ornamental purposes soon becoming a serious weed. As early as 1859 it was included in the first catalogue of garden plants issued by the Adelaide Botanical Gardens and was probably introduced some time before that date. By 1890 both species were established as weeds in South Australia, Victoria and Western Australia and their appearance in New South Wales was not long delayed.

Although probably first introduced to this State as a garden subject it has since been distributed in several other different ways. Hay and chaff cut from infested paddocks have been responsible in many cases and Cape Tulip occurs on a number of old camp sites where horses were fed. Stock and farm machinery have played their part along with subterranean clover burr and ungraded lines of clover seed. The weed has been distributed with gravel used for ballast, also with packing material and in balled fruit trees. It favours moist situations and has been spread along gullies by running water.

DESCRIPTION

The vernacular name is derived from the country of origin, South Africa, where species of *Homeria* are referred to as "tulps." *H. Breyniana* is known as One-leafed and *H. miniata* as Two-leaved Cape Tulip.

Homeria Breyniana has a single, ribbed, grass-like leaf 12 inches or more long arising from a corm (the so called bulb) which is surrounded by brown fibrous material. The stem is shorter than the leaf and produces a few flowers which are, at first, enveloped by green spathes. Each flower has six segments which are usually predominantly pink with a green or yellow base, but are sometimes entirely yellow. The flowers often exceed an inch in diameter. The narrow cylindrical seed vessel opens at the top to liberate numerous brown seeds.

Homeria miniata has two, or sometimes more, grass-like leaves and in consequence is often referred to as Two-leaved Cape Tulip. These arise from a corm around which are formed numerous cormils (small

* *Homeria Breyniana* (L.) Lewis was formerly known as *Homeria collina* Vent.

Fig. 1.—Two-leaved Cape Tulip from Cuballing August 30. Cormils have developed freely on the untreated plants on the left, while the plant on the right sprayed with 2, 4-D ester on July 13 is unthrifty, has no cormils and has the characteristic swelling immediately above the corm.

"bulbs") the whole being surrounded by dark fibrous material. The flowering stem gives rise to a number of flowers which emerge from green spathes. Each flower has six segments, pink in colour with the exception of the yellow base which is often blotched with green. The diameter of the flower seldom exceeds one inch. During the later stages of growth, groups of cormils are formed in the angles formed by the leaves and the stem. Although *H. miniata* flowers freely, no plants bearing seed have been noted in this State.

SIGNIFICANCE

Where the growth of Cape Tulip is dense, especially in parts of the Avon Valley, desirable plants are largely crowded out and in many cases the carrying capacity has been reduced by at least 50 per cent. Besides being a weed of major importance it is also a poisonous plant which has caused toxic effects even when dry.

South African natives have been poisoned by eating the corms of Cape Tulip and there are many references to losses of animals. Deaths are reported most frequently among cattle, although horses and sheep are also affected, and there is no reason to believe that pigs are immune. There is evidence to show that the poison occurs in all parts of the plants irrespective of whether fresh or dry, and an alkaloid, homeridine, has been isolated.

Animals accustomed to grazing in areas where Cape Tulip is prevalent are seldom affected, probably because they avoid eating the plant. Even under these circumstances, however, deaths occur from time to time. The most serious mortalities have been experienced among stock brought from a district free of Cape Tulip to one where the weed is present in quantity. On a number of occasions deaths have occurred in a few hours.

Further details concerning toxic properties and symptoms can be obtained from an article by C. A. Gardner and

Fig. 2.—One-leafed Cape Tulip showing stages of corm development. On June 26 the old (lower) corms of the two plants on the left had commenced to shrivel but the new corms above them were only at an early stage of formation. At this stage or a little later the weed is most vulnerable to ploughing. By August 20 the three plants on the right from York and Williams had new corms nearing maturity. At this stage ploughing is not fully effective although the plants are still susceptible to 2, 4-D.

H. W. Bennetts—"Poison Plants of Western Australia—The Cape Tulip" in the November-December, 1952, issue of this journal.

Both species are declared primary noxious weeds for the entire State.

CONTROL

As already mentioned Cape Tulip was present in Western Australia before the beginning of this century and during the past 50 or 60 years has been allowed to establish itself with little opposition. We cannot hope to overcome the problem in a few years, in fact Cape Tulip along with many other weeds will always be with us but there is much we can do to reduce its impact on agricultural production.

The present policy is to concentrate on those areas which are relatively small but are acting as foci for distribution. In such cases eradication is possible. With large infestations the primary objective is to prevent further spread at the same time systematically tackling the area with a view to reducing its extent.

When considering the control of weeds, particularly perennial weeds such as Cape Tulip, it is important to take into account their life-history. This is underlined by the two closely related species of Cape Tulip. The two-leaved type, although flowering freely, does not produce mature seeds but these are replaced to a large extent by a considerable number of small cormils which form around its basal corm or bulb and also in the angle between the leaves and the flowering scape. On the other hand the one-leafed type seeds freely and also multiplies by the formation of a few corms at the base but does not produce the characteristic cormils of the

A to I—ONE-LEAFED CAPE TULIP *(Homeria Breyniana* (L.) Lewis); A and B—Habit; C and D—Corms (D in section showing development of lateral corm); E—Flower; F—Flower in lateral view; G—Ovary, stamens and styles; H—Fruit (capsule); I—Seeds (much enlarged).

K to L—TWO-LEAVED CAPE TULIP *(Homeria miniata* Sweet); K—Habit; L—Cormils. Metropolitan District. Icon. origin.

(Drawing by the Government Botanist, Mr. C. A. Gardner. From the series "Poison Plants of Western Australia.")

Fig. 3.—Two-leaved Cape Tulip showing young plants developing from cormils surrounding the corm. The photograph was taken on July 18.

other species. It is obvious that prevention of seeding alone will not eradicate Cape Tulip and attention must also be given to both the corms and cormils.

Although well adapted for propagation and not easy to control, good results have been obtained with both cultural and chemical methods.

Ploughing should be carried out with a disc or mouldboard, or a rotary hoe used when the corms are at the transition stage. This stage, which is dependent to a certain extent on the season and soil conditions, usually occurs in July. The old or lower corm has shrivelled appreciably and the new or upper corm or corms have only partially formed.

In order to be effective, ploughing must be done thoroughly to the depth of the corms. Half turning the plants will allow many of them to continue growing and a cultivation following the ploughing is often necessary.

Owing to the presence of dormant corms, complete destruction with one operation is not possible although a big reduction, at times more than 90 per cent. has been obtained in the first year. For this reason, ploughing, grubbing or chemical treatment must be continued for several years. The proportion of dormant corms can be reduced by having little dry herbage on the surface at the beginning of autumn. A fire helps in this respect.

On some land it is possible to sow an early-maturing crop following ploughing at the critical time but much Cape Tulip infested land is too boggy to plough at the time most favourable for the control of the weed. With land of this nature it is better to plough early than to wait until the soil becomes firm in the spring. A cropping and fallowing programme continued for several years has effected a big improvement on several properties in the Avon Valley. Crops should be cut for hay only if no mature seeds or stem cormils are present. At times cropping with peas fits into such a control programme, particularly in the Avon Valley.

Although cultural operations must be accepted as the first line of attack, the value of an effective chemical has always

Fig. 4.—Two-leaved Cape Tulip at Cuballing showing the control on a 30 ft. strip sprayed at the rate of 2 lb. acid equivalent of 2, 4-D amine with a low volume boom on July 14, 1952. Photograph May 27, 1953.

been recognised. Fence lines, rocky situations and uncleared country present difficulties for ploughing, along with boggy areas which have already been mentioned. Many chemicals have been tried over a period of years mainly with indifferent results.

Some degree of control has been obtained by the application of oils including a mixture of old sump oil with kerosene or diesolene at the rate of one gallon per 24 square yards of Cape Tulip. Results have been variable, however, and the treatment is very costly.

Four years ago some encouraging results were obtained with trials with 2,4-D or hormone-like preparations. Comprehensive experiments have since been undertaken over a wide area extending from Geraldton to Cranbrook and a number of farmers sprayed appreciable areas last season. We have learnt much from these experiments and also from the large scale operations.

The highest degree of control and most uniform results have been obtained with 2 lb. of acid equivalent of 2,4-D ester per acre of Cape Tulip. Good results have also been associated with the same rate of both the amine and sodium salt of 2,4-D. On occasions these have been just as effective as the ester, but at other times have been somewhat inferior.

Under favourable conditions, especially in the case of fairly sparse infestations, one pound of acid equivalent per acre has caused a substantial reduction. For reasons of economy this rate may be used to advantage under some circumstances where maximum reduction in the first year is not of primary importance. With spot spraying of scattered growth the higher rate is strongly recommended.

Both high and low volume treatments have proved effective. Application can be made by means of a knapsack, a hand lead from a power unit or a low-volume boom. 100 gallons per acre, i.e., one gallon per 48 square yards is a convenient rate when using a knapsack or a hand lead although some operators prefer considerably less, especially with a hand lead. Complete coverage, however, is important. With low volume boom units eight gallons per acre is a satisfactory rate. Some experimental applications from the air were made last year but results cannot be assessed until emergence time which will occur shortly.

It is important to ensure that the quantity of chemical required per acre is contained in the volume used.

The most appropriate time for application varies somewhat with the season and is not the same for the two species. With the two-leaved type, July treatments at the corm transition stage favoured for ploughing have proved satisfactory and the work can be continued into August. The optimum time for the one-leafed species is somewhat later, August being the main month, with satisfactory work also being undertaken in September. In several instances plants sprayed at the early bud stage have been killed and the associated new corms affected. Further experiments designed to define with more certainty the suitable time range for the two species are in progress.

Light rain a few hours after application is unlikely to reduce the efficiency of the treatment, but, as far as possible, spraying should be undertaken in fine weather or at least when rain is not imminent.

Some time often elapses before any effect of 2,4-D on Cape Tulip can be noticed, in fact an accurate estimation of results is not often possible before the growing period in the following season. The most obvious symptoms are a twisting of the foliage along with a swelling of the basal portion of the plant above the corm.

With spraying, as with ploughing, the dormant corms are a problem. In many cases more than 90 per cent. control has been obtained in one season but measures must be continued for several years. The most practical programme varies with conditions and often spraying one year can be followed to advantage by ploughing and cropping in the subsequent year or the reverse order may be favoured.

A number of proprietary lines of 2,4-D ester are available, mostly containing about four pounds of acid equivalent per gallon. The cost of one pound of acid equivalent is approximately £1, but the cost of treatment should be considered as a debit against the whole property rather than the affected portion for, if active measures are not taken against this weed when present in small proportions, it will soon become a problem over an extensive area.

Fig. 1.—The ripping tynes mounted in front of the tractor. At the left, the three tynes are shown in the carrying position. At right, the two outer tynes are down in the ripping position.

A WARREN-RIPPING INNOVATION

Agriculture Protection Board Operates a New Front-End Ripper

By A. R. TOMLINSON, Chief Vermin Control Officer.

THE ripping-up of rabbit warrens has proved to be one of the most effective rabbit control techniques yet applied in Western Australia. Apart from the many rabbits destroyed in the warrens during ripping operations, it was found that the destruction of their harbourage left the surviving rabbits an easy prey to foxes and other natural enemies, besides depriving them of snug breeding quarters.

During 1952, the Agriculture Protection Board purchased a large warren-ripping outfit consisting of a D4 Caterpillar tractor and three-tyned Tracquip roll-over ripper with a low-loader semi-trailer truck for transportation. This outfit was extensively used for demonstration purposes and was also made available to farmers on a hire basis.

While this type of ripper gave excellent results on warrens situated in fairly open country, it was found that none of the orthodox tractor-drawn rippers could effectively destroy warrens situated near rocks, in fallen timber, close to fences and in similar awkward spots.

The advantages of a ripper that preceded the tractor instead of following it were obvious, and the Vermin Control Officer in charge of warren-ripping operations (Mr. G. Atkinson) reported that a small front-end ripper of this type was being used by Mr. J. Walsh of Northam.

On April 15, 1953, Mr. Walsh kindly arranged a demonstration of his machine. It was, of course, a much smaller outfit than that envisaged by the Agriculture Protection Board, but the performance was so impressive that all who witnessed it were convinced that a front-end ripper would solve most of their warren destruction problems.

Fig. 2.—Front view of the three tynes in the ripping position.

Fig. 3.—The ripper in operation.

Despite considerable scepticism concerning the feasibility of applying the principles to a large-sized tractor, the present attachment was planned and manufactured by the State Engineering Works, with the advice of officers of the Mechanical and Plant Engineer's Branch, the Vermin Control Branch of the Department of Agriculture and the Perth representatives of the tractor firm (Messrs. Wigmores Ltd.).

The Board's D4 Caterpillar tractor was fitted with three ripping tynes mounted in front of the tractor on a framework fitted to a hydraulically-operated bulldozer pushing-bar.

The tynes have a maximum penetration of 32 in. and may be swung individually into a carrying position so that one, two or three tynes may be used. The points are angled forward so that ripping may be carried out right up to—and even slightly under—logs, fences, boulders and other obstructions.

Small trees can be pushed down by the machine, while the angling of the tynes permits them to be used like an elephant's tusks for lifting and rolling logs and boulders.

The outfit operates speedily and effectively in open country and is ideal for operating on creek banks. An added advantage of the front-end ripper is that the tracks, carrying the full weight of the machine, follow the tynes and help to consolidate the ripped ground.

Some problems have already been encountered in operating the hydraulic lift which is subjected to much greater stresses and strains and far more frequent usage than on the bulldozer for which it was designed.

The Government engineers and the technical staffs of the tractor and hydraulic equipment firms are giving this matter their close attention and are confident that the difficulties can be overcome.

Despite these difficulties with the hydraulic lift, the outfit has been operating in the Moora district since September, 1953, and work has now been completed on 16 properties with a total area of 40,000 acres. The machine has done 475 hours of actual ripping at the time of writing (March, 1954).

CHARGES TO FARMERS

The outfit is made available to farmers at an inclusive charge of £2 17s. an hour.

The average cost of operation was 11s. 5d. per warren (including travelling between warrens) for areas varying from 6 yds. x 6 yds. to 17 yds. x 20 yds.

Cost per square yard varied from 0.29d. for the largest, to 1.4d. for a small difficult warren.

The country ripped included heavy soil and stones, bad gullies, light soils (not sandplain), hilly areas and a number of timber-covered warrens.

The Agriculture Protection Board has been complimented on its development of the idea by engineers who have seen the outfit at work, and local farmers have expressed their appreciation of the enterprise shown by the Board in performing a necessary work at a reasonable cost.

Fig. 4.—Using the ripper to push aside a fallen tree-trunk.

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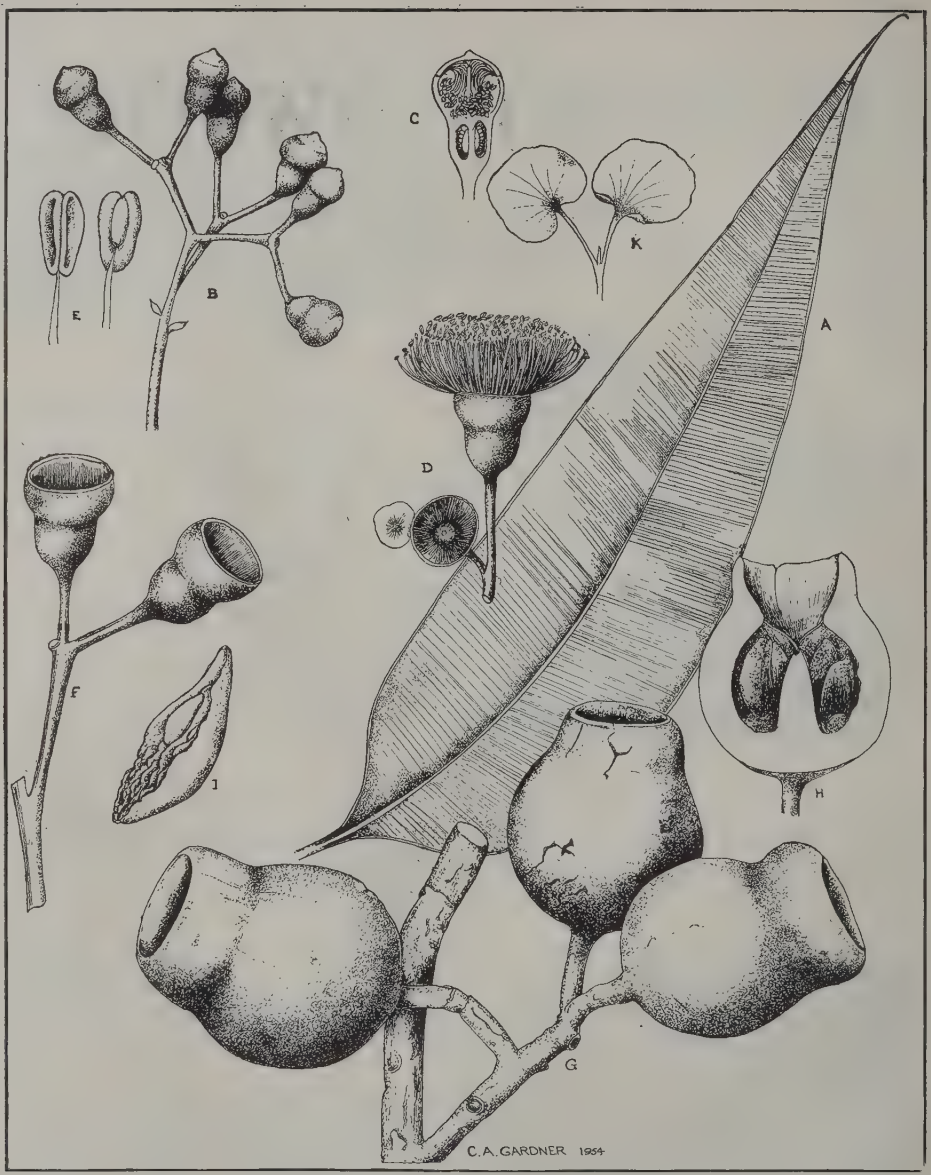

MARRI *(Eucalyptus calophylla* R. Br. ex Lindl.). A—Leaf; B—Portion of inflorescence with flower-buds; C—Flower-bud in section; D—Flower and calyx after flowering with the operculum still attached; E—Anthers; F—Young **fruits**; G—Cluster of fruits; H—Fruit in section; I—Seed; K—Cotyledons.

Perth, W.A. Icon origin.

TREES OF WESTERN AUSTRALIA

By C. A. GARDNER, Government Botanist.

No. 25—MARRI

(Eucalyptus calophylla R. Br. ex Lindl.)

THE Marri tree is one of the commonest and best-known of the large trees of South-Western Australia. It has a range of distribution extending from Port Gregory near the Murchison River, to Cape Riche, westward and southward to the coast, and inland slightly beyond the eastern limits of the jarrah zone. Tinkurrin is probably the most inland of the areas in which it is found.

Although one of the largest trees of the jarrah forest, it occurs as a small tree or a shrub in its eastern limits on the south coast, while to the north of the Hill River it suffers considerable reduction in stature. In the forest areas however, it attains a height of well over 100 feet.

The Marri belongs to the group of *Eucalyptus* which are called bloodwoods, i.e., trees with a friable bark; leaves with a characteristic parallel lateral nervation of veins close together and spreading from the midrib almost at right angles; flowers which although in umbels have these umbels arranged in larger panicles; woody globular or urn-shaped fruits, and a bud cap or operculum which rarely falls freely, but shows a tendency to remain hinged to the calyx-tube at the time of flowering (see illustration).

Although the bloodwoods are familiar objects in the tropical woodlands, twelve species being found in tropical Western Australia, there are only three in South-Western Australia, these being the Marri, the red-flowered gum, and the mountain gum of the Nannup and Jarrahwood districts to the south of Busselton. The Marri can usually be recognised at once by its large leaves which are dark green above and paler underneath; its wide spreading, often horizontal, thick branches; its large white or pale pink flowers, and its urn-shaped fruits of large size, typically with a "neck" or constriction below the wide terminal orifice.

Occurring freely in the jarrah and karri forests it favours the lighter, somewhat sandy soils, a fact which no doubt accounts for its prevalence in the sandy coastal areas, and its comparative absence from the clay soils of the wandoo forest. A gum-resin or kino is formed in cavities in the wood, or in vessels below the bark, and is sometimes exuded in fair quantities. This kino has a value as a tanning material, but its collection today for this purpose is uneconomical.

Marri timber is straight-grained and pale in colour. Foresters consider it a durable timber, and it may possess a future for use as sleepers. The Marri is also well known to the apiarist, giving a copious supply of nectar in suitable seasons. It flowers in the summer months, usually in February and March, but may continue until April or May. The timber is straight-grained and pale in colour. The leaves yield small quantities of an oil which consists mainly of terpene and is of no commercial value.

The name *calophylla*, given to this species by Robert Brown who was the botanist accompanying Flinders in 1801-1802, signifies beautiful leaf, and Lindley, who first published the name in 1841, remarks in its similarity to that of a species of *Calophyllum*. Brown remarked that the tree was the only useful timber tree growing on the shores of King George's Sound.

As early as 1838 the early settlers knew the tree under the name of red-gum, but the Swan River natives called it "N'gum-

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We may refer to the subject of this article, and incorporate the introduction of Mobile Power Saws to assist the timber man generally to speed up timber production. A most interesting feature emphasises the importance of these machines as major equipment in view of and quoting statistical figures that approximately 1,000 "New Dennis" Drag and Circular Power Saws are in operation throughout Australia, and are being constantly used by Timber Mills, Firewood Cutters and Farmers, which substantiates the suitability of these machines to capably handle all and various timbers, clearing and fencing. The constant demand for the "New Dennis" machine emphasises the importance of this Power Saw as major equipment on any Timber Mill or Farm.

In conclusion a mention should be made of the grand programme mapped out by our Forestry Department in re-afforestation for the future needs of this State.

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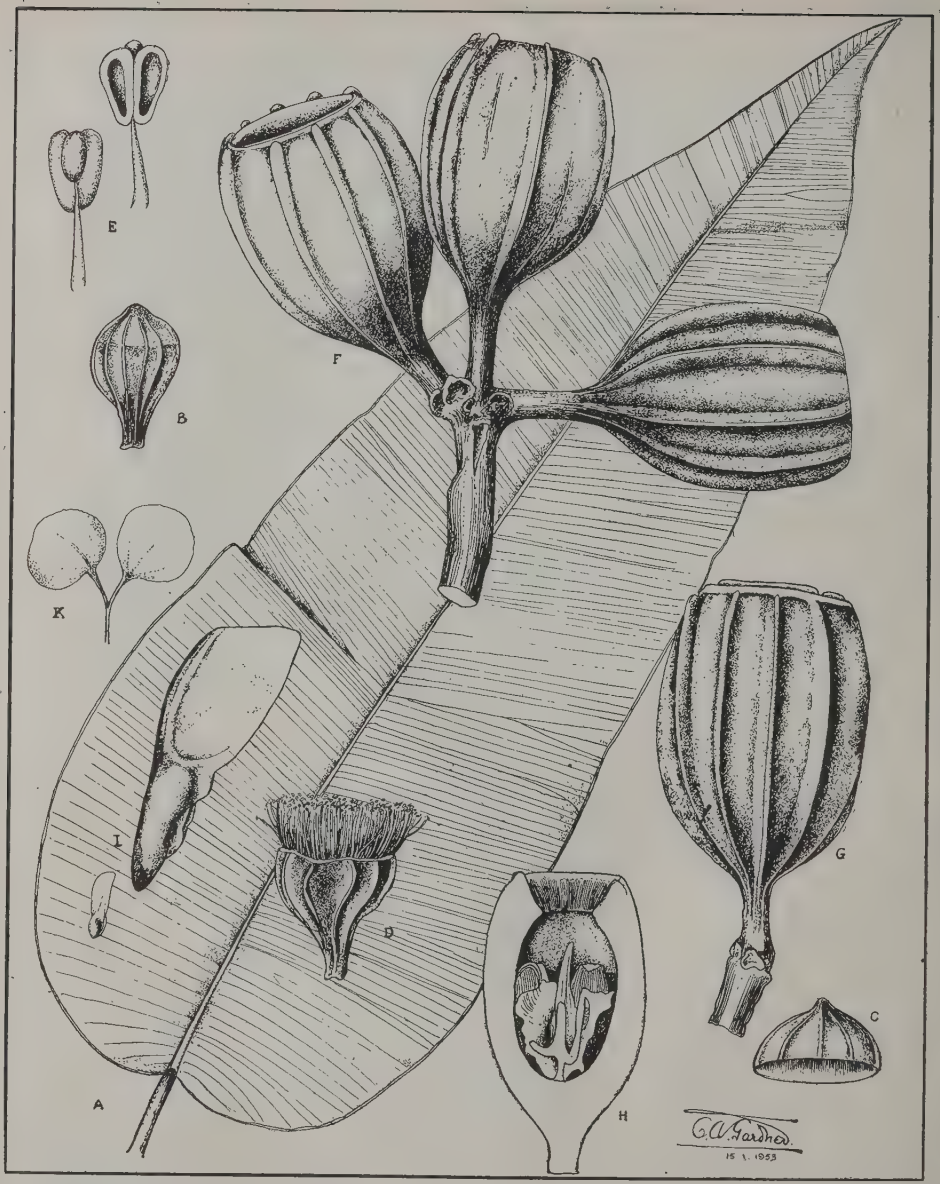


SPRING BLOODWOOD (*Eucalyptus ptychocarpa*, F. Muell.). A—Leaf; B—Flower-bud; C—Operculum (bud-cap); D—Flower (less than natural size); E—Anthers; F—Fruits; G—Single fruit; H—Fruit in section; I—Seeds; K—Cotyledons.

Lawley River, Gardner 1458. Icon origin.

bat." Other native names were "Kurden" or "Karden," and "Marri" or "Marree." Mr. C. E. Lane-Poole, a former Conservator of Forests, initiated the substitution of the name Marri for red-gum, to avoid confusion with the red-gum of Victoria and South Australia *(E. camaldulensis)*, and after 40 years this name has now a general application except amongst some of the older residents, who continue to call it "red-gum." Children know the fruits as "hockey nuts."

On account of its singularly attractive habit of growth and dense crown, and its large white or pale pink flowers, the tree is of considerable value to the farmer and country dweller as a shade tree. Indeed, the prevalence of this tree in farming lands along the lower Great Southern districts adds very considerably to the beauty of the landscape, and its value there for shade purposes for stock is obvious. Like other species of *Eucalyptus,* it develops best when given space in which to develop its roots and lateral branches.

The two most closely-related species to the Marri in South-Western Australia are the red-flowered gum *(Eucalyptus ficifolia)* and the mountain gum *(Eucalyptus haematoxylon.)*. The former, now widely planted in many parts of the world, differs from the Marri in being a smaller tree with smaller, more rigid and deeper green leaves; flowers of a brilliant vermilion or sometimes crimson; fruits usually without any "neck," and brown winged seeds. Like the Marri it has a pale timber: the mountain gum has red timber; oil-dotted leaves, and reddish-brown winged seeds; otherwise it much resembles the Marri, but is a smaller crooked tree.

When not in flower, the Marri and red-flowered gum may very closely resemble each other, but can usually be distinguished by the foliage; an absence of oil-dots in the leaves, reddish branchlets (often purple) and smaller and narrower leaves are characters which usually suffice to separate the two.

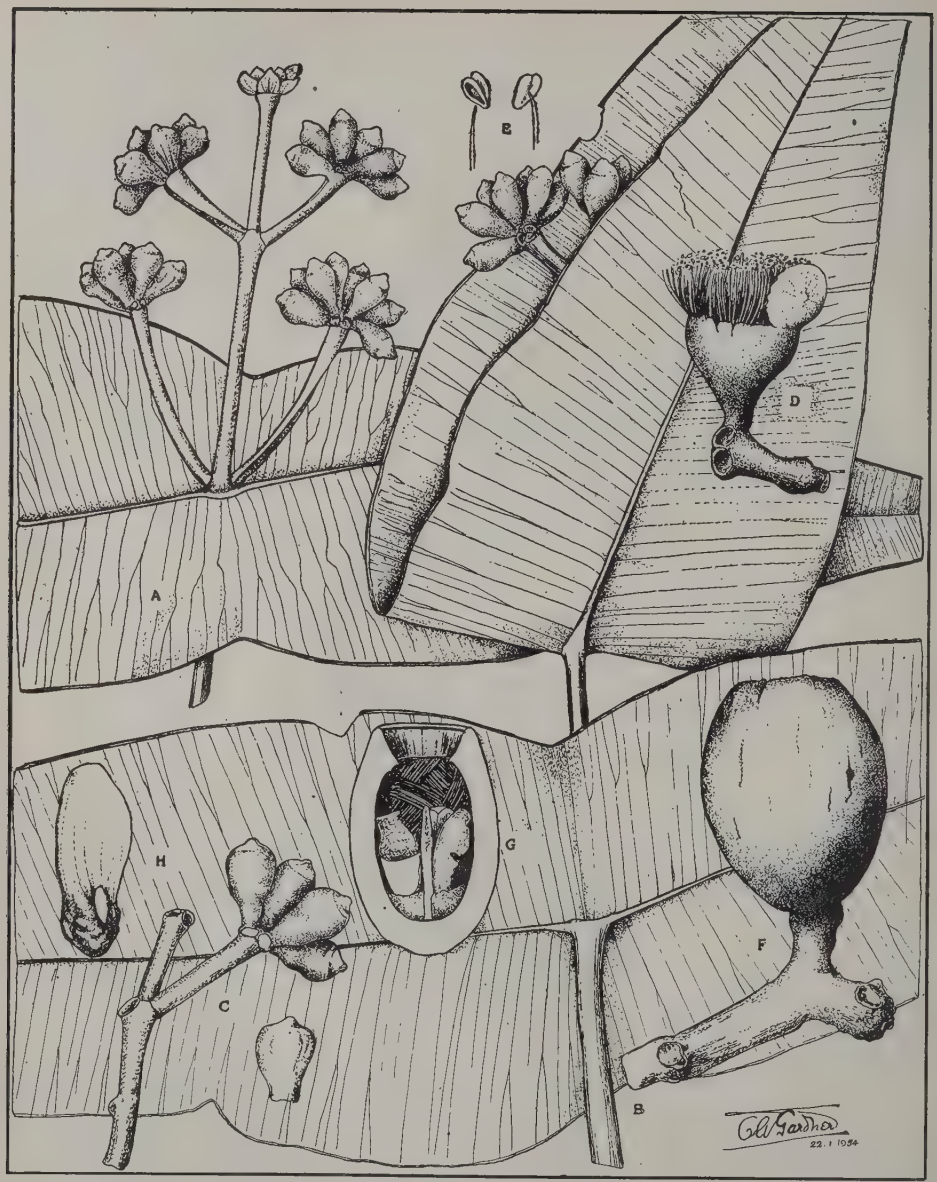
No. 26—SPRING BLOODWOOD

(Eucalyptus ptychocarpa F. Muell.)

THIS tree is one of the most attractive of the genus Eucalyptus. In appearance it much resembles the Marri, but is of still broader branching habit, and has broad leaves which are not usually thick, are of a bright green on the upper surface and vary from about five to twelve inches in length. This magnificent tree occurs in the Kimberley Division in a few favoured spots associated with fresh water at shallow depths, and may be used as an indicator of such. It rarely exceeds 35 or 36 feet in height, but the trunk is frequently three feet in diameter. The bark is rough and fibrous-flaky like that of the Marri, and is deep brown in colour. The branches are widely spreading or drooping, and the timber is soft and deep red in colour.

In Western Australia the Spring Bloodwood is only found in a few areas, including the Drysdale River district, the Lawley and Prince Regent Rivers, the Isdell and Charnley Rivers and their tributaries, and Cockatoo Spring near the lower reaches of the Ord River. It has all the characteristics of the bloodwood tribe (the *Corymbosae)* as discussed under the marri, but differs from them all in its eight-ribbed fruit. The name *ptychocarpa,* given to it by Mueller, means "folded fruit." These ribs, present also on the flower-buds, I have always found to be eight in number, but although typically narrow and prominent, they may be occasionally obscure. The flowers are usually white or a pale pink, and the tree flowers in March and April.

There has been much discussion as to the colour of the flower filaments. In Western Australia only white, or a very pale pink colour, has been observed; Leichardt described a Port Essington speci-



TWIN-LEAVED BLOODWOOD (Eucalyptus perfoliata R. Br. ex Benth). A—Leaves and inflorescence with buds; B—Leaves; C—Flower buds; D—Flower; E—Anthers; F—Fruit; G—Fruit in section; H—Seeds. Roe River, Gardner (fruits). Icon origin.

Gogo, Fitzroy River.
Gardner 9795.

men as carrying "scarlet blossoms," but this has been doubted by later botanists. More recent observers have described both crimson and scarlet blossoms, as well as white.

Recently, when travelling along the upper country of the Roper River, about 60 miles from Katherine, I saw a sight that cannot easily be forgotten—a grove of these trees with massive trusses of brilliant crimson flowers in great profusion. The filaments were the colour of blood, and their presence in such abundance made the tree a splendid sight. The Spring Bloodwood would be a powerful rival to our well-known red-flowered gum were it in cultivation, as the combination of crimson flowers and heavy foliage makes the trees particularly attractive. The flowers were certainly not scarlet as stated by the earlier observers Leichardt and Gulliver.

The blossoms were very rich in nectar, and the tree would be of value to the apiarist did it occur in sufficient numbers. Where sufficient moisture occurs, this tree should have a prominent place in tropical gardens, surpassing both in habit, density of crown and colour and massiveness of its inflorescences, the better-known woolly-butt *(E. miniata)*.

No. 27—TWIN-LEAVED BLOODWOOD

(Eucalyptus perfoliata R. Br. ex Benth.)

THIS tree inhabits stony hills and rises in the Kimberley Division, and it stands unique amongst Western Australian species with a single exception—a tree of the desert and the Hamersley Range—E. gamophylla) in having its paired leaves united at the base so that the stem or branch appears to grow through the leaf.

It is fairly abundant along the Roe and Moran Rivers in North Kimberley, where it appears as a crooked tree 15 to 20 feet in height. The Twin-leaved Bloodwood is also found on the sandstone ranges southward from the King Leopold Range, notably on the St. George Range, and on the hills around Gogo Station. It is of little commercial value, and is remarkable rather than handsome. The name perfoliata refers to the shape of the leaves. (A perfoliate leaf is one in which the leaf-blade completely surrounds the stem on which it grows, or has the appearance of having the stem grow through the leaf.)

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THE CHEMICAL CONTROL OF WILD RADISH

By G. R. W. MEADLY, M.Sc., Officer in Charge, Weeds and Seeds Branch, and G. A. PEARCE, B.Sc. (Agric.), Botanist.

WILD radish (Raphanus raphanistrum) and wild turnip (Brassica Tournefortii) occur over a very wide area in Western Australia and are two of the most troublesome weeds of cereal crops. In a period of three years the area sprayed with hormone-like weed-killers for the control of these weeds has increased from experimental proportions to an estimated total of 400,000 acres in one season.

Although results from the application of these chemicals to wild turnip have been uniformly good, in most cases, particularly with aircraft application, the control of wild radish has not been completely satisfactory. Most of the spraying has been undertaken with the amine and sodium salt of 2,4-D and the sodium salt of M.C.P.A.

With a view to comparing these treatments and ascertaining whether better results could be obtained with the esters of 2,4-D, a trial with wild radish in wheat was commenced at Southern Brook on 7th August, 1953. The sodium salt of M.C.P.A. and the amine, ethyl ester and butoxyethanol ester of 2,4-D were applied by means of a low volume boom at the rates of four and six ounces of acid equivalent in five gallons of water per acre.

Fig. 1.—The first reaction of wild radish to hormone-like weed-killers—a twisting and "propping" of the foliage.

The butoxyethanol ester was included because it is less volatile than the more frequently used ethyl ester and therefore has less risk of damaging nearby susceptible crops. Cereals are known to be less tolerant to both these preparations, however, and results had to be gauged on the effects on the cereal as well as the weed. The chemicals mentioned are available in a number of proprietary lines. Table 2 gives details of those that have come to the notice of this Department.

Three replications of each treatment were made to plots 12 feet wide and three chains in length. At the time of spraying the growth of the crop was even, the wheat being about eight inches high and stooling. There was a moderate to fairly heavy infestation of wild radish at the rosette stage with foliage 6-8 inches in length. The soil was of a sandy nature and the weather was fine.

The effects of the treatments were assessed by visual observations at several times during the season and also by yields of grain. The four ounces of acid equivalent per acre of M.C.P.A. and 2,4-D amine affected a proportion of the wild radish plants but did not give a satisfactory degree of control. The six ounce rate of both gave practical control although some plants recovered and set seed. There was

no visual difference between the two types of ester but the results with four ounces of acid equivalent per acre were somewhat better than those with six ounces of amine and M.C.P.A. The six ounces rate of the esters gave complete control of the radish.

Table 1 shows the various treatments along with the estimated degree of control of wild radish and actual crop yields.

TABLE I.

Treatment.	Chemical.	Ounces acid equivalent per ac.	Crop yields per ac. bushels.	Per cent. Control.
1	M.C.P.A.	4	24	60
2	2,4-D amine	4	25	75
3	2,4-D ester	4	24½	100
4	2,4-D.L.V. ester	4	25	100
5	M.C.P.A.	6	23	80
6	2,4-D amine	6	24	85
7	2,4-D ester	6	24	100
8	2,4-D.L.V. ester	6	23	100

Although there was a marked difference in the degree of control of wild radish there was no significant difference between treatments as far as yields were concerned. The long season and favourable moisture conditions in the spring undoubtedly minimised the affect of weeds on yields. Unfortunately, owing to a misunderstanding, yields were not taken from unsprayed control areas but these carried a heavy growth of wild radish reaching higher than the crop. Harvesting of the untreated area was very difficult owing to choking of the comb and the resulting grain contained a quantity of wild radish seeds.

As a result of the trials that have been described along with field observations it is possible to make some recommendations concerning wild radish which should achieve better and more consistant results.

1. **Time of Spraying.**—This is best correlated with the growth stage of both the crop and the weeds. The "safe period" for wheat is between stooling at 6-8 inches in height and the early "boot" stage when the head is enclosed in the sheath of the flag leaf. Risk of damage continues during pollination but resistance again increases at the late "milk" and "soft dough" stages. We have had little experience with spraying weeds in oats and barley but it is known that oats is a more sensitive crop than wheat with barley intermediate. Depression of yield with oats has occurred even with spraying carried out at the time considered most appropriate.

Wild radish plants should be sprayed when small as they are then most vulnerable to the chemical and are also destroyed before becoming an important competitor for the crop. Furthermore the cereal then provides the weed with little protection from the chemical. When wheat is 6-8

Fig. 2.—A wheat crop containing wild radish at the growth stage suitable for spraying.

Fig. 3.—The effectiveness of the spray treatment is illustrated by the dense growth of wild radish on an unsprayed strip in a crop near Northam. Field peas may be seen in the crop in the right foreground.

inches high, usually most of the radish plants have germinated but are still relatively small and susceptible. Undoubtedly much spraying of wild radish is carried out too late to be most effective.

2. **Conditions.**—Fine, warm weather without a strong wind is desirable. Rain a few hours after treatment, particularly when using the ester, is unlikely to be detrimental but spraying should not be carried out when rain is imminent. Weeds are most readily killed when making active growth and some poor results have followed spraying after a dry period when the growth of the weeds was retarded.

3. **Type and Amount of Chemical.**—The ester of 2,4-D is favoured for the treatment of wild radish in wheat. For general control purposes, providing conditions are favourable, four ounces of acid equivalent per acre is recommended. When complete control is desired, or application is being made by aircraft, six ounces should be applied. If M.C.P.A. or the amine or sodium salt of 2,4-D is used a minimum of six ounces of acid equivalent per acre is recommended.

When a crop is undersown with a legume the susceptibility of the species used must be taken into account. Although some information is available, tolerance trials with the Dwalganup strain of subterranean clover will be continued during the coming season. It is known that generally legumes are less affected by M.C.P.A. than by the ester of 2,4-D with the amine in an intermediate position.

Experiments and observations so far indicate that subterranean clover will withstand rates of at least eight ounces of acid equivalent per acre of the types mentioned but in a number of instances a delay in the flowering time has been noted. In short seasons this could mean that the soil may not remain moist long enough for seed setting to be completed. Under such circumstances old-established pastures would normally develop the following season from hard seeds in the soil but such a reserve would not exist in the first year of sowing.

It is stressed that the recommendations concerning the ester apply to wild radish. Wild turnip is destroyed by four ounces

TABLE 2.—AVAILABLE CHEMICALS

The availability of the following proprietary lines has been indicated to the Department of Agriculture by the distributors.

Trade Name.	Distributor.	Type.	Acid Equivalent. *	Quantity containing the following amounts of acid equivalent.			
				4 oz.	6 oz.	8 oz.	1 lb.
Methoxone 30	Elder, Smith & Co., Ltd.	MCPA sodium salt	2·7 lb. per gal.	14½ fl. oz.	20⅞ fl. oz.	29 fl. oz.	58¼ fl. oz.
Shell Weedkiller M	Westralian Farmers Co-op., Ltd.	MCPA sodium salt	2·7 lb. per gal.	14½ fl. oz.	20⅞ fl. oz.	29 fl. oz.	58¼ fl. oz.
Tuloxone 30	Co-op Wholesale Services / Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	MCPA sodium salt	2·7 lb. per gal.	14½ fl. oz.	20⅞ fl. oz.	29 fl. oz.	58¼ fl. oz.
Hart's 2, 4-D Sodium Salt	Harris, Scarfe & Sandovers, Ltd.	2, 4-D sodium salt	80% powder	5 oz.	7½ oz.	10 oz.	20 oz.
Nocweed 2, 4-D Sodium Salt	Tropical Traders & Patersons, Ltd.	2, 4-D sodium salt	85% powder	4¾ oz.	7 oz.	9½ oz.	19 oz.
Phenoxone	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D sodium salt	82% powder	5 oz.	7½ oz.	10 oz.	20 oz.
2, 4-Diweed	Wigmores, Ltd.	2, 4-D sodium salt	70% powder	5⅜ oz.	8⅛ oz.	11 oz.	23 oz.
W.F.C.L. 2, 4-D	Westralian Farmers Co-op., Ltd.	2, 4-D sodium salt	85% powder	4¾ oz.	7 oz.	9½ oz.	19 oz.
Wilmex	Wilcox Mofflin, Ltd.	2, 4-D sodium salt	85·5% powder	4⅝ oz.	7 oz.	9½ oz.	19 oz.
Afenox	Strickland & Pittaway & Co. Ltd.	2, 4-D amine	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Amoxone	Elder Smith & Co., Ltd. / Westralian Farmers Co-op., Ltd.	2, 4–D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
David Gray's 2, 4-D amine	David Gray & Co., Ltd.	2, 4-D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Diweed 50	Wigmores, Ltd.	2, 4-D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Elliots 2, 4-Ditox	Felton Grimwade & Bickford, Ltd.	2, 4-D amine	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Hart's Killamine	Harris, Scarfe & Sandovers, Ltd.	2, 4-D amine	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Hormex 5X	Wilcox Mofflin, Ltd.	2, 4-D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Nocweed A.	Tropical Traders & Patersons, Ltd.	2, 4-D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Shell Weedkiller D.	Shell Co. of Aust., Ltd.	2, 4-D amine	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Weeder 77	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D amine	4·8 lb. per gal.	8⅓ fl. oz.	12½ fl. oz.	16⅔ fl. oz.	33⅓ fl. oz.
David Gray's 2, 4-D ester	David Gray & Co., Ltd.	2, 4-D ethyl ester	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Difenox	Strickland & Pittaway & Co., Ltd.	2, 4-D ethyl ester	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Elliots 2, 4-Destox	Felton Grimwade & Bickford, Ltd.	2, 4-D ethyl ester	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Estex 40	Wilcox Mofflin, Ltd.	2, 4-D ethyl ester	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Estex 80	Wilcox Mofflin, Ltd.	2, 4-D ethyl ester	8 lb. per gal.	5 fl. oz.	7½ fl. oz.	10 fl. oz.	20 fl. oz.
Estone 80	Elder, Smith & Co., Ltd. / Westralian Farmers Co-op., Ltd.	2, 4-D ethyl ester	8 lb. per gal.	5 fl. oz.	7½ fl. oz.	10 fl. oz.	20 fl. oz.
Hart's Kill-Ester	Harris, Scarfe & Sandovers, Ltd.	2, 4-D ethyl ester	8 lb. per gal.	5 fl. oz.	7½ fl. oz.	10 fl. oz.	20 fl. oz.
Nocweed E.	Tropical Traders & Patersons, Ltd.	2, 4-D ethyl ester	5 lb. per gal.	8 fl. oz.	12 fl. oz.	16 fl. oz.	32 fl. oz.
Shell Weedkiller E.	Shell Co. of Aust., Ltd.	2, 4-D ethyl ester	4 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Weedone Concentrate 57	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D ethyl ester	3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
Weedone L.V. 57	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd. / Elder, Smith & Co., Ltd.	2, 4-D butoxy-ethanol ester	3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
Butoxone	Westralian Farmers Co-op., Ltd.	2, 4, 5-T butyl ester	8 lb. per gal.	5 fl. oz.	7½ fl. oz.	10 fl. oz.	20 fl. oz.
David Gray's 2, 4, 5-T	David Gray & Co., Ltd.	2, 4, 5-T butyl ester	3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
Hart's Killaberry 1600	Harris, Scarfe & Sandovers, Ltd.	2, 4, 5-T butyl ester	7·5 lb. per gal.	5⅓ fl. oz.	8 fl. oz.	10⅔ fl. oz.	22¼ fl. oz.
Lotex	Wilcox Mofflin, Ltd.	2, 4, 5-T butyl ester	4·0 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Nocweed 2, 4, 5-T	Tropical Traders & Patersons Ltd.	2, 4, 5-T butyl ester	3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
Shell Weedkiller B.	Shell Co. of Aust., Ltd.	2, 4, 5-T mono-butyl glycol ester	3·0 lb. per gal.	13¼ fl. oz.	20 fl. oz.	27⅔ fl. oz.	53 fl. oz.
Weedone Special 2, 4, 5-T	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4, 5-T butoxyethanol ester	3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
			2, 4-D. / 2, 4, 5-T.				
Di-Ester	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D plus 2, 4, 5-T	2 lb. per gal. / 2 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Diweed 5T. Concentrate	Wigmores, Ltd.	2, 4-D plus 2, 4, 5-T	2 lb. per gal. / 2 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Elliot's 2, 4, 5 Tritox	Felton Grimwade & Bickford, Ltd.	2, 4-D plus 2, 4, 5-T	2 lb. per gal. / 2 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Hart's Killaberry 800	Harris, Scarfe & Sandovers, Ltd.	2, 4-D plus 2, 4, 5-T	3·7 lb. per gal. / 3·7 lb. per gal.	5⅛ fl. oz.	8 fl. oz.	10¾ fl. oz.	21½ fl. oz.
Hi-Ester	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D plus 2, 4, 5-T	3·5 lb. per gal. / 3·5 lb. per gal.	5⅛ fl. oz.	8⅛ fl. oz.	11⅓ fl. oz.	23 fl. oz.
Nocweed Brushkiller	Tropical Traders & Patersons Ltd.	2, 4-D plus 2, 4, 5-T	1·8 lb. per gal. / 1·6 lb. per gal.	11⅓ fl. oz.	17⅓ fl. oz.	23⅓ fl. oz.	47 fl. oz.
Nocweed Brushkiller 80	Tropical Traders & Patersons Ltd.	2, 4-D plus 2, 4, 5-T	3·6 lb. per gal. / 3·6 lb. per gal.	11 fl. oz.	17⅓ fl. oz.	22¼ fl. oz.	44½ fl. oz.
Trimex	Wilcox Mofflin, Ltd.	2, 4-D plus 2, 4, 5-T	2 lb. per gal. / 2 lb. per gal.	10 fl. oz.	15 fl. oz.	20 fl. oz.	40 fl. oz.
Weedone Brushkiller	Dalgety & Co., Ltd. / Goldsbrough Mort & Co., Ltd.	2, 4-D plus 2, 4, 5-T	1·6 lb. per gal. / 0·8 lb. per gal.	16⅔ fl. oz.	25 fl. oz.	33⅓ fl. oz.	66⅔ fl. oz.

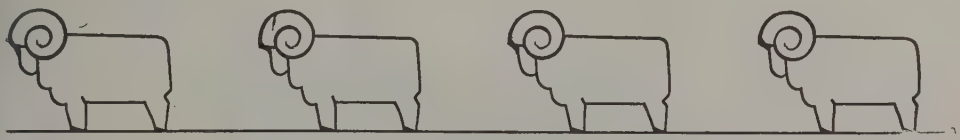
One pint contains 20 fluid ounces.

of acid equivalent per acre of the ester but the same quantity of the other chemicals mentioned has also proved effective.

4. **Accuracy of Treatment.**—With the use of such very small quantities of chemicals it is obvious that mixing must be done accurately and application made with precision. This calls for a spraying unit capable of giving an even distribution with a low volume. Six to ten gallons of solution per acre are usually applied at a pressure of approximately 25 lb. per square inch. It is not sufficient to set the gauge at a defined pressure, then travel at a fixed speed and assume that the estimated and required volume is being applied. A constant check of the volume used against the acreage covered should be maintained and even partial blockage of jets should be corrected immediately.

ACKNOWLEDGMENT

Thanks are due to Messrs. Dwyer Bros., Southern Brook, who readily co-operated and made their property available for experiments.



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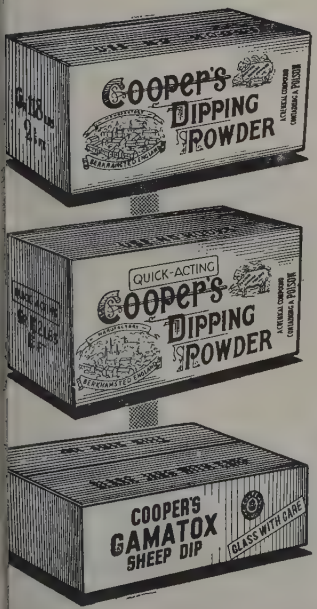

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THE NATIVE PEAR AS A TOXIC PLANT

By R. D. ROYCE, B.Sc. (Agric.), Botanist.

THE Native Pear (Xylomelum angustifolium) has recently been associated with stock losses in the Marchagee district, and a sample of the leaves of sucker shoots, which were submitted for chemical analysis, showed small amounts of prussic acid. This is the first occasion on which the species has come under notice as a toxic plant, although a related species (X pyriforme), which occurs in the Eastern States, has long been known to contain the same toxic principle under certain circumstances.

The losses were experienced on a property in sandplain country three miles east of the siding. On three separate occasions deaths were reported, and each time within 24 hours of the flock being turned into a stubble paddock of over 1,000 acres which had recently been cleared and was carrying the stubble of its second crop. Tests and post-mortem examinations had failed to establish any diseased condition, and a poisonous plant was suspected.

A botanical survey of the area showed a number of seedlings and sucker shoots of native plants, many of which had been freely eaten by the sheep. With two exceptions, these plants were known to be harmless, and some were well known fodder plants. Of the two suspected plants, Corkbush (*Gyrostemon ramulosus)* was not eaten to any extent, and was not considered to be responsible for the losses. The second plant, Native Pear, occurred mainly as suckers 3 to 4 feet in height, and these had been heavily grazed; moreover, the stomach contents of all the sheep examined after death, showed a proportion of the leaves of this species. Subsequently, samples of the succulent and vigorously growing sucker shoots were submitted to the Director of the Government Chemical Laboratories for analysis, the results of which proved them to contain prussic acid.

In the absence of controlled feeding trials the evidence against Native Pear is not complete, but there is little doubt that this plant was responsible for the losses experienced. As this is the first occasion on which the plant has been suspected of possessing toxic properties, this result is of some interest. However, Native Pear, like all prussic acid producing species, is

The Native Pear.

probably of little economic significance as a poisonous plant. There are so many factors which can affect the production of this poison in plant tissues that it is only on rare occasions that the toxicity is developed.

Mature leaves of Native Pear have long been regarded by farmers as a useful feed, and sheep have shown some preference for them in bush country. They appear to be palatable, and on several occasions the lower branches of trees have been denuded of leaves as high as the sheep have been able to reach. It would appear that only the sappy young leaves, of either sucker shoots or seedlings, which develop after clearing operations and fires, are likely to cause trouble, the mature and more fibrous leaves being harmless.

Similarly, the well known Paddy Melon and the common Goosefoots (*Chenopodium pumilio* and related species), although capable of causing heavy mortality when conditions are favourable for the production of prussic acid, are regarded by many farmers as useful summer fodder plants. While conditions are unfavourable for the production of the toxic principle, the plants will continue to be of value in the summer months, but if conditions suddenly become favourable, losses will probably occur.

Native Pear is a member of the *Proteaceae* or Banksia family, and is one of the few plants in this very large group which has been proved toxic. It is a small tree of 10 to 12 feet in height, and is usually of a low branching and bushy habit. The flowers are borne in large clusters at the extremities of the branches and are large and showy. They are followed by the woody pear-like fruits which hang on the branches unopened until the tree is killed by fire or destroyed by some other means, when the drying out of the pears liberates the seeds.

The tree is confined to sandplain areas northwards from Moora, and extending eastwards of the Wongan Hills-Mullewa railway line. It occurs abundantly on large tracts of country which will undoubtedly be developed as pastoral holdings in the near future, and although it can not be classed as anything more than a very minor toxic species, the possible results of grazing sheep on sucker or seedling growth of the plant may well be borne in mind.

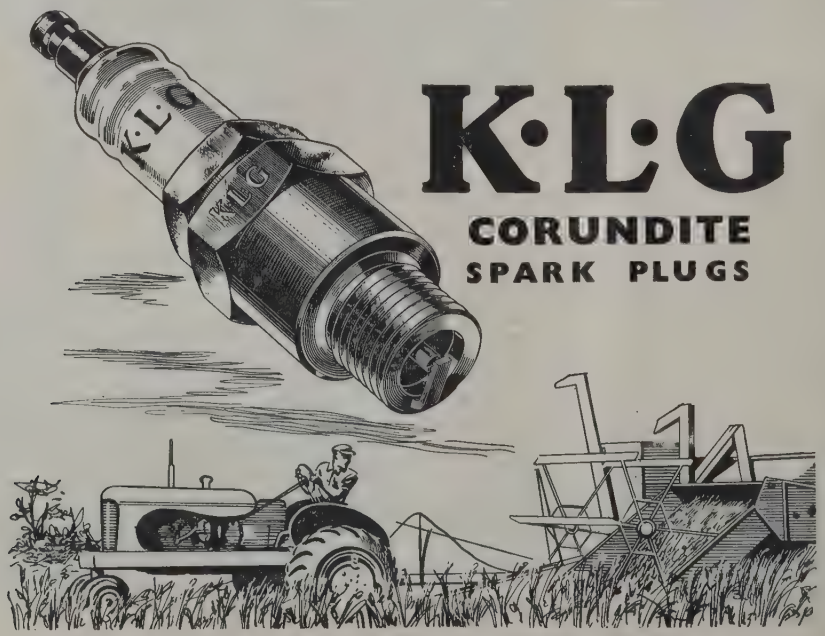

Fig. 5.—The completed framework of a large intensive poultry house ready for roofing. In this case a hip roof has been used instead of a gable. The bungalow design with open wire netted walls, is ideally suited to the deep litter system. The generous overhang of the eaves may be observed at the far right-hand corner of the shed. The photograph was taken on one of the "pilot" poultry farms.

DEEP LITTER FOR POULTRY

Part 2.—The Deep Litter Poultry House

By L. J. GAFFNEY, B.Sc. (Agric.), Poultry Adviser.

WELL-designed poultry houses are essential if good results are to be obtained from the deep litter system, especially where the birds are intensively housed. The heavy concentrations of droppings falling on restricted floor areas call for a technique of litter management in which the design of the buildings plays a very important part.

This will be readily apparent if we remember that the moisture content of the droppings may comprise 70 to 85 per cent. of the total weight.

About one-third of the total dry matter consumed by hens on standard poultry rations is passed out in the excreta, so that 100 laying birds consuming six tons of dry feed in a year would void about two tons of dry matter in their droppings. Add to this some five to ten tons of moisture and it will be readily realised that the maintaining of the litter in a satisfactory condition presents some problems.

Since most of the moisture must be eliminated by evaporation, poultry houses should be designed to give full play to such natural drying elements as sunshine and free ventilation.

GABLE-ROOFED HOUSES

In the past it was general practice to house laying birds in small units, and narrow skillion-roofed sheds were suitable for the purpose; but with a changeover to intensive farming, the wide gable-roofed poultry house for accommodating a large number of birds has come into prominence. This type of shed is particularly well suited to the deep litter system because it can be easily and cheaply designed to keep out the rain while at the same time admitting the abundance of fresh air and sunlight so necessary for maintaining the litter in a dry condition.

SUNLIGHT VENTILATION AND SHELTER FROM RAIN ARE ESSENTIAL

Most poultry farming districts in Western Australia experience mild winter conditions, so that the main consideration in housing poultry during the winter months is to afford shelter from rain. Under the deep litter system it is of utmost importance to ensure that driving rain cannot penetrate into the shed. Rain-sodden litter is very difficult to dry out in a damp winter atmosphere and, unless removed from the shed, damp litter can be a real menace. It is a relatively simple matter however to make a gable-roofed shed rainproof by extending the overhang of the roof at the eaves. Naturally, the weather side of the building requires most protection from wind-swept rains and it may be necessary for the lower section of the wall facing the weather to be closed in.

As a general rule, poultry houses should be erected with their longest measurements running approximately north and south, with the front of the house facing east so that during winter when the sun's rays reach the earth at a low angle in the early morning and late afternoon, they are directed below the eaves of the gable roof allowing parts of the floor to be bathed in sunlight for a few hours every day. Direct sunlight is an excellent drying and and disinfecting agent and is a source of ultra-violet light. The birds delight in dust-bathing in the sunlit areas of the floor and the farmer is thus relieved of the necessity for continually stirring these portions of the litter.

Open wire-netted walls provide ideal ventilation for a deep litter shed. A continuous circulation of fresh air over the floor permits surface evaporation and removes harmful fumes and odours. Strictly speaking, recourse to the closing-in of the wall of a long house should only be taken as a protection against rain, as protection from the cold is not usually necessary

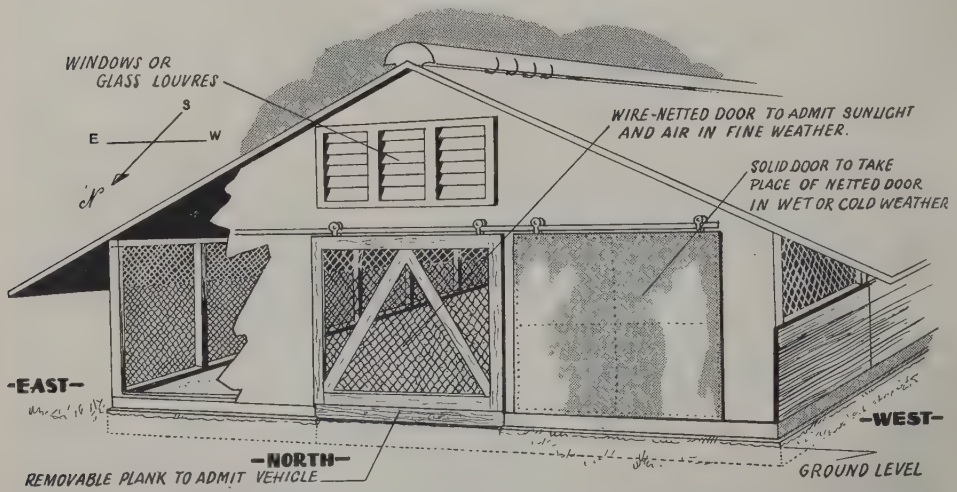

Fig. 6. –This sketch shows some of the main constructional features of a large gable-roofed shed sited to give protection from north-westerly rains. The eastern and western walls are of wire netting and are protected by the substantial overhang of the eaves. The lower portion of the western wall is closed in to prevent rain driving on to the litter. If movable frames covered with flat galvanised iron or asbestos-cement sheeting are used for closing in the western wall it is a simple matter to adjust the ventilation or shelter according to the requirements of the season.

The shed is built on a concrete foundation extending about 10 inches below ground level with a concrete upstand or low wall built up 10 in. above the concrete floor. The upstand is interrupted at the northern end where a wide doorway permits the entrance of a vehicle for cleaning out the shed. A length of 10 in. plank drops into slots at the bottom of the doorway and serves to retain the litter. It can be lifted out to allow a vehicle to enter.

Two sliding doors are fitted, one a frame covered with wire netting to admit air and sunshine, the other a solid sheeted door to give shelter from rain or cold winds. Windows or glass louvres high in the wall admit sunlight and air.

Ventilation ridge-capping is used to cover a 4 in. gap at the ridge of the roof.

under local conditions. Winds are not a problem with gable-roofed houses in well-chosen situations.

It will usually be necessary to close in the north and south end walls of the shed unless a verandah is built to cover in these sections. The northern end will be facing the sun for a large part of the day and sunlight should be admitted by installing glass louvres or windows high up in the wall. A large sliding door in the centre of the north end wall will allow the entry of the farmer's vehicle when the time arrives for the shed to be cleaned out. This doorway could also be used to admit sunlight, if a door or pair of doors, made from wire netting stretched over a light timber framework, are made to fit in the place of the sliding wooden door.

Sunlight and fresh air are beneficial to deep litter and stock alike. They are freely provided by nature and the farmer should endeavour to exploit their usefulness.

THE RETAINING WALL AND CONCRETE FLOOR

One of the first steps in building the ideal deep litter house is to put in concrete foundations to a depth of about 10 in. below ground level. These footings should be put in around the perimeter of the shed and should be about 6 in. wide. The upper surface of the foundations should be at least 1 in. above the highest point of the surrounding earth. A concrete wall or upstand 4 in. wide should be erected on top of the footings and should rise to a height of 10 in. above the projected floor level. This wall serves the dual purpose of retaining the litter and providing the strong foundation for the walls of the shed structure. It also greatly reduces the risk of white ants and wood-rotting fungi damaging the building timbers.

A flat concrete floor at least 3 in. in thickness with a smooth cement surface should then be laid. Concrete is preferred to a dirt floor as it facilitates cleaning out operations and lessens the risk of dampness impregnating the litter.

EQUIPPING A DEEP LITTER SHED

In equipping a deep litter shed with such items as waterers, feeders, perches and nests, an allowance of about 6 in. must be made for the depth of litter in order to maintain the equipment at a suitable height above the litter, the depth of which will naturally vary from time to time.

Fig. 7.—A skillion-roofed poultry house measuring 32 ft. by 16 ft. The back and ends of the building are closed in, while the front of the building facing away from the weather has the lower portion built of asbestos-cement sheeting and has an overhanging roof to protect the litter. This design is not suited to maintaining a dry, friable litter as very little direct sunlight reaches the floor and ground ventilation is poor.

Note the drinking platform extending outward from the wall with the water-trough in front of a grid of vertical steel rods.

Waterers

Particular attention must be given to installing the watering system as damp areas around the drinking vessels can be breeding places for internal parasites. In order to avoid water spilling on the litter, the waterers are installed just outside the house, but are accessible to the birds from the inside. The birds stand on a slatted platform made of two 2 in. x 1 in. boards spaced 1½ in. apart. This extends outwards above the concrete floor. The birds reach the water by poking their heads through a grid of vertical rods spaced 2½ in. apart. Any water that adheres to the wattles and bills as the birds are drinking, falls outside the shed and damp patches in the litter are avoided.

Fig. 8.—A solid concrete upstand 10 in. above the floor and 4 in. wide carries the building shown in Fig. 6. The 4 in. x 2 in. wallplate resting on the upstand and secured by bolts set into the concrete gives added depth to the retaining wall, allowing for the build-up of 12 in. of litter. The floor is of concrete with a smooth cement surface. The floor should be at least 3 in. thick and at least 1 in. above ground level.

A concrete dropping trap situated beneath this outside platform is used for retaining the manure that falls between the slats as the birds are drinking.

Where the birds are provided with outside runs, a similar platform is built on the other side of the drinking vessel.

Feeders

Trough feeders are the best for providing adequate feeding space inside the poultry house, but there are two problems associated with deep litter that must be overcome. Firstly, there will be a concentration of droppings around the feeders and with the birds constantly treading on this area of the floor, the litter has a tendency to pack down. Avoid this by changing the position of the troughs, stirring the litter around the feeders frequently and replacing it with dry, friable litter from other parts of the floor. The second problem is to prevent the litter getting into the feeders. By placing a house brick under each end of the trough so that the bottom of the latter stands about 2 in. above the litter there is less chance of the birds scratching the litter into the troughs and furthermore the bottom of the trough will last longer. An anti-perch roller will discourage the birds from walking over the troughs and soiling the feed.

Perches

It is common experience to find that the perches in a deep litter shed are too close to the surface of litter because allowance has not been made for the increasing depth of litter material. This is a serious oversight and may result in ammonia fumes causing irritation to the birds. Also when the perches are low the birds are reluctant to work the litter beneath the perches and the droppings are more likely to cake on the surface. To overcome these difficulties and to facilitate culling, the perches should be arranged at a uniform height of 3 ft. 6 in. from the concrete floor.

Nests

If suitable and adequate nesting accommodation is provided in the shed just prior to the start of lay, very few eggs will be laid on the floor. A few birds will invariably choose to make their own nests in dark areas of the litter, but by placing some obstruction in the way of each nesting place they will eventually use the proper nests. Eggs laid on dry floor litter will be only very slightly soiled. The bottom of the nest is usually placed about 3 ft. above the concrete floor.

Removing the Litter

At some time during the year, more usually when the new season's pullets are approaching the lay, the deep litter house is cleared of stock and this is an appropriate time to remove all or part of the old litter. Sometimes the farmer has occasion to do this when the litter becomes extremely damp or when outbreaks of certain diseases or an infestation of internal parasites occurs. Most poultrymen prefer to remove all the litter when cleaning out time arrives, rather than leave a small quantity of the old litter to promote a quick build up of a micro-organism population in the new material. This is a judicious practice as it enables the farmer to thoroughly disinfect the buildings each year and the new stock is not exposed to any carry-over of harmful organisms.

If the fresh litter material is introduced during the summer there is no urgency for rapid decomposition to take place as the litter is easily managed at this time of the year. When only a shallow depth of litter is used at the start, the whole body of material soon decomposes and by winter time it should be in a highly absorbent condition.

CHEMICAL ANALYSIS OF DEEP LITTER

The fertiliser value of deep litter samples can be determined from chemical analysis but it would be impossible to give an average analysis which could be used as a general standard. Such variable factors as stocking rate, housing system, age of litter, and the method of management and treatment of the litter will all affect the levels of the various elements present. Obviously there is a greater accumulation of manure in the floor litter when the flock is intensively housed throughout the year than when the birds are provided with a run. Obviously too, the concentration of manure will be greater when less litter material is mixed with it. The management of the litter must also influence the retention or loss to the atmosphere of volatile substances such as ammonia. It was mentioned previously that the addition of superphosphate in preference to hydrated lime might reduce the escape of ammonia. If this were the case, both the nitrogen and phosphorus levels of the litter would be increased by the addition of superphosphate.

PERCENTAGE COMPOSITION OF TWO SAMPLES OF DEEP LITTER

Taken From Pilot Farms

	Sample 1.	Sample 2.
Moisture	9.31	9.22
On Dry Basis		
Organic matter (estimated from organic carbon)	49	50
Nitrogen (N)	1.69	2.01
Calcium (Ca)	2.80	4.24
Phosphorus (P)	1.32	2.27
Potassium (K)	0.83	1.09
Ash insoluble in acid, mainly silica	32.0	20.0
Total ash	45.5	39.5

The analyses show that Sample 2 contains considerably higher levels of N, P and K compared with Sample 1. The deep litter of Sample 2 was taken from a large intensive poultry house where the flock was permanently confined. Sample 1 was taken from a similar large poultry house but the birds were confined only when weather conditions did not favour allowing them out to run. The management and treatment of the two deep litters were not identical.

PRINCIPAL ELEMENTS OF DEEP LITTER

(Percentage weight on dry basis)

	Sample 3.	Sample 4.
Nitrogen	2.12	1.77
Phosphorus	3.09	2.58
Potassium	0.88	0.79
Calcium	2.85	2.64
Sulphur	0.22	0.18
Iron	0.28	0.58
Magnesium	0.37	0.34
	(plus trace elements)	

The analyses show that deep litter contains moderate amounts of a wide range of the elements utilised by plants in addition to supplying a large quantity of organic material in a partly decomposed state.

Owing to the difficulties in standardising the fertiliser value of deep litter the product is generally sold at a uniform price which does not recompense those farmers producing samples of litter of superior fertiliser value. Both buyer and seller should give more consideration to the conditions under which the deep litter has been developed and relate this to the price of the product. In this way the farmer would be given an incentive to produce a high quality litter of considerable fertiliser value and would receive a greater remuneration. A mutual arrangement should exist between the poultry farmer and the purchaser of deep litter so that greater benefit can be derived from this valuable poultry by-product.

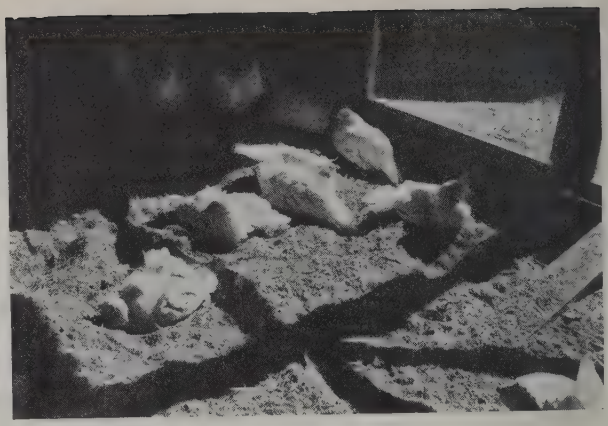

Fig. 9.—These birds are dust-bathing in sunlit areas of litter. Their scratching stirs the droppings into the litter which absorbs the moisture. Ventilation and sunshine promote evaporation of the moisture.

THE USE OF LITTER IN THE BROODER HOUSE

The majority of chickens in this State are brooded on the floor under a wide variety of brooding systems. Most brooder houses are provided with a concrete floor covered with 3 to 4 in. of clean dry litter material such as sawdust and buzzer chips. These are good insulating materials which absorb and retain heat from the brooder and mix with and assist in dissipating the moisture in the droppings.

Damp litter is even a greater hazard in the brooder house than in the laying quarters, and although there is not such a great accumulation of excreta on the floor, the brooder compartment generally holds a moist atmosphere and the litter tends to become damp in places underneath and around the brooder. Chickens camping on damp litter, with ammonia fumes being liberated, can suffer from chills and pneumonia, and although the birds may survive, growth may be seriously retarded. Furthermore, coccidiosis which is a very prevalent disease in chickens, thrives under moist conditions, and a quick build-up of the organisms responsible can cause irreparable damage. With a little care and attention to the condition of the litter, these risks can be minimised.

Firstly, only perfectly dry litter material should be used and this should be heated by the brooder for several hours prior to introducing the young chicks. Watering fonts should be placed on grids which stand on the cement floor for rigidity and the litter underneath should be removed so that any drops of water will spill on the cement floor. After the first two or three days, the litter underneath the brooder should be inspected and if there are signs of dampness or of droppings accumulating on the surface, a light application of hydrated lime to the litter, followed by forking-in, will maintain the little in a dry state. It may be necessary to replace the damp litter underneath the brooder with dry material from another area of the compartment.

It should be emphasised that strict attention must be constantly directed to the condition of the litter during the brooding period. Although the brooder house must be kept comfortably warm and free from draughts, this does not preclude admitting adequate ventilation and sunlight on to the floor. Baffled ventilators, sections of louvres and "window-light" are invaluable for this purpose if placed in the correct position.

With respect to the rearing of chickens on old built-up litter carried over in the brooder house from year to year, this practice has gained prominence in the United States where all-the-year-round hatching

lends itself to this system of rearing. In this State with few exceptions, the litter is renewed with each new batch of chickens as this method is simpler and disease control is more certain.

Particular care in the management of deep litter and a thorough understanding of the way in which it functions is essential if the deep litter system is to operate successfully in the brooder house. If the farmer is unable to satisfy these conditions, it would be most unwise for him to take the risk of rearing a large number of chickens on deep litter. Many authorities maintain that chickens benefit considerably from old litter, claiming that it absorbs moisture more readily; it contains certain growth-promoting nutrients and it can be used to control the build-up of coccidiosis so that the chick acquires a gradual immunity against the disease early in its life. These claims can only be verified by controlled experiments, but from local observations there is reason to believe that deep litter under good management may assist in controlling heavy chick losses, caused by a sudden and heavy infection of coccidiosis. If this can be shown to be the case under local conditions, then more chickens will be reared on deep litter in the future.

Fig. 10.—Fertilising pasture paddocks with poultry deep litter. This photograph was taken in April by Mr. E. R. Bocquet on his property in the Albany district where he runs poultry, sheep and a few head of cattle. In the establishment and maintenance of high quality pastures, Mr. Bocquet considers that the deep litter from his poultry houses supplies practically all the fertiliser requirements of his soils. On the poorer sandy class of land, the application of deep litter has enabled him to develop outstanding pastures in a very short space of time. Mr. Bocquet uses the straw from his pastures as material for his deep litter.

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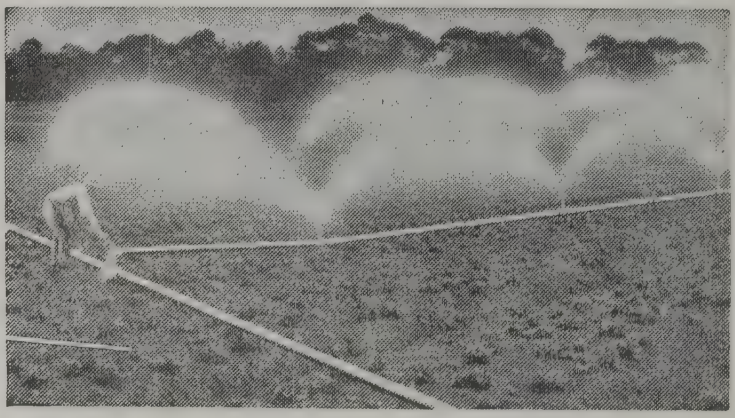

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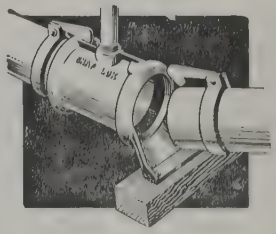

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PLANT DISEASES

CEREAL SMUT DISEASES AND THEIR CONTROL

By W. P. CASS SMITH, B.Sc. (Agric.), Government Plant Pathologist.

THE well-known smut diseases of wheat, oats and barley are caused by fungal parasites which produce masses of soot-like fungal seeds or spores in the plants they attack, and it is from this dark coloured spore material that the name "smut" is derived.

Until about the early 1920's, the cereal smuts were responsible for heavy economic losses, but today the damage that they cause is relatively insignificant. There are two main reasons for this beneficial change; firstly, improved scientific knowledge has led to the development of more effective control measures; and secondly, the necessity for routine application of these measures yearly is now widely appreciated by farmers.

It must be emphasised however that the cereal smuts have not been eradicated, and where control measures are neglected these diseases may soon multiply and again become very damaging.

With one exception, the smut diseases which attack wheat, oats and barley are **head smuts,** i.e., they give rise to smut masses which appear more or less conspicuously in the heads or ears. Covered smut or bunt of wheat, loose smut of wheat, and the smuts of oats and barley are examples. In the case of **flag smut** of wheat however, the smut masses develop in the leaves and stems where they are less obvious.

The head smuts of cereals are of two types, known respectively as **"covered"** and **"loose."**

Covered smut is so named because the smut masses which replace the normal grain remain enclosed by a skin or membrane until the crop is harvested, when they are broken up into a spore dust which contaminates the healthy grain.

Loose smut, on the other hand, replaces both the grain and chaff with powdery spore masses which are only loosely held and thus are gradually blown away by wind, until at harvest time the rachis or stalk of the ear is more or less bare.

Each of the cereal smuts is caused by a distinct species of fungus which has its own characteristics and life-history; and the smuts which attack wheat, cannot attack oats, or barley.

LOOSE SMUT OF WHEAT

Loose or flying smut of wheat caused by the fungus *Ustilago tritici* is common in our wheat areas but is seldom present in serious amounts. Affected plants become conspicuous in the early heading stage when both the grain and chaff of diseased ears is replaced by the loose, dark, powdery spore material (see Fig. 1).

The loose smut fungus can only infect other wheat plants at the flowering stage. The spores in affected ears are readily dispersed by wind, and if they lodge on the open flowers of other wheat plants they germinate and penetrate the embryo grain. Cool humid weather when wheat crops are flowering favours infection, whereas hot dry conditions reduce the spread of the disease.

At harvest time, infected grain appears healthy and normal in size, but as it contains the threads of the loose smut fungus, it will give rise to smutted plants in the following crop if used for seed purposes.

Control:

As the fungus is carried **internally** in infected seed, dusting the seed **externally** with copper or mercury containing dusts is ineffective. A hot water disinfection treatment has been devised but this operation is a complicated one. If loose smut becomes prevalent, healthy seed should be obtained either from one of the Department's Research Stations or from other clean crops in the district.

COVERED SMUT OR BUNT OF WHEAT

This disease is also known as ball smut or stinking smut and it is caused by the parasitic fungi *Tilletia caries (T. tritici)* and *Tilletia foetida (T. levis)*.

Fig. 1.—Loose smut of wheat. Note that the powdery spore masses are gradually dispersed until at harvest time the stalk of the ear is more or less bare.

Fig. 2.—Covered smut, bunt or ball smut of wheat. At right diseased heads, and bunt balls which replace the grain. At left, healthy heads and grain.

The disease is characterised by the formation in the ears, of smut or bunt balls, instead of normal grain (Fig. 2). These have an objectionable odour like putrid fish.

When an affected crop is harvested many of the bunt balls are crushed, and the powdery spore dust which is thus released contaminates the healthy grain.

As one bunt ball may contain several million fungal spores, extensive contamination of the grain can occur even when the disease is apparently not very prevalent in the crop.

As is well known smutty wheat is unsuitable for milling and is subject to price dockage.

Unlike loose smut of wheat, infection of wheat with covered smut occurs at the seedling stage, from grain contaminated with spores during harvesting operations.

When contaminated seed is planted, both seed and spores germinate together and the young seedling is infected. Fortunately, under our conditions, little if any infection occurs from contaminated soil and therefore the disease is readily controlled by seed disinfection with suitable fungicides.

Control:

Dry-pickling with standard copper dusts, e.g., copper carbonate or copper oxychloride at dosages of 1½-2 oz. per bushel has been standard practice locally for

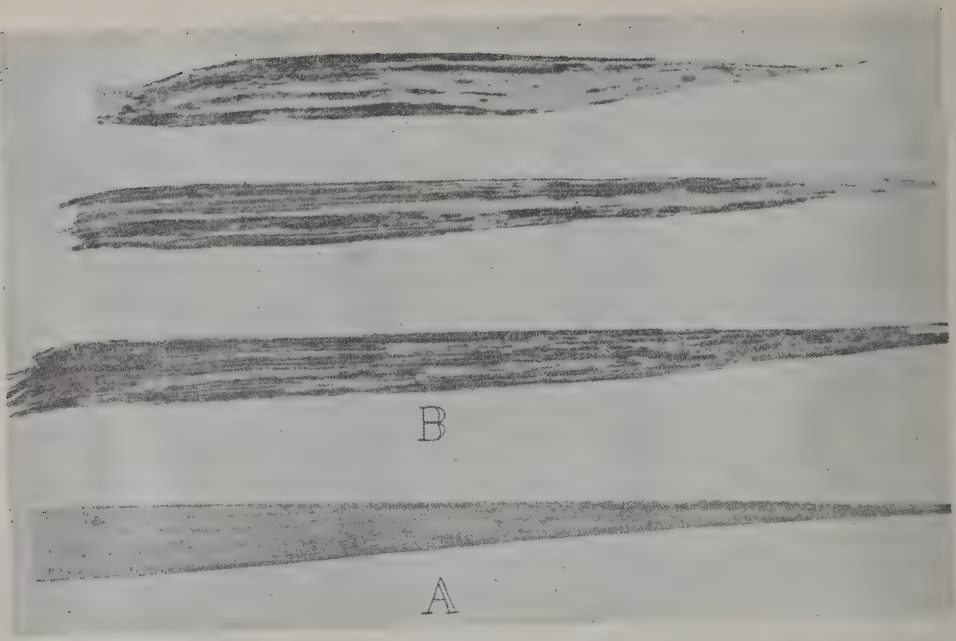


Fig. 3.—Flag smut of wheat, showing healthy leaf (A) and diseased leaves (B). Note dark linear streaks characteristic of this disease.
(After Simmonds.)

many years and has proved so effective that today bunt of wheat is comparatively rare, except where treatment has been neglected or improperly applied. Organic mercury dusts at the same dosage are just as effective but they have not been recommended by this Department in the past for the control of this disease because until recently they cost more than the copper compounds.

Recently a material known as hexachlorbenzene (H.C.B.) has been developed specifically for the control of bunt or ball smut of wheat.

Tests conducted here during the last two years have shown that H.C.B. dusts are just as effective for bunt control as the copper or organic mercury compounds.

However, the copper and mercury dusts will also kill flag smut spores that may be transmitted by the seed, but H.C.B. is unsatisfactory for this purpose.

For this and other reasons the general use of H.C.B. in preference to the well tried copper or organic mercury dusts, as the standard dry-pickle for wheat cannot be recommended.

Whatever dust is used for dry-pickling seed wheat, an adequate dosage as recommended by the manufacturer, and thoroughness of application are essential.

To ensure that this is achieved, contract grading and dry-pickling operations should always be supervised by the grower.

It is sometimes claimed that 2 oz. of copper or mercury dust will not adhere properly to a bushel of wheat as this dosage is excessive. However, if this difficulty is experienced, the fault lies either with the dry-pickling machinery or the manner in which it is operated.

FLAG SMUT OF WHEAT

This disease of wheat caused by the fungus *Urocystis tritici* is potentially a very serious one as older farmers know only too well. In the 1920's, flag smut was spreading rapidly not only in W.A., but in other wheat-producing States of the Commonwealth and jeopardised Australian wheat

production. Losses in yield of 10 to 15 per cent. were common and in some cases almost total crop failure resulted.

Fortunately it was discovered in this State that the locally-bred variety Nabawa was resistant to flag smut and, largely because of this quality, Nabawa which was grown on a small acreage only in 1925, became by 1932 the most popular Australian wheat variety.

Symptoms and Life-history:

As the name of the disease indicates, the flag smut fungus causes smut masses to develop in the leaves and leaf sheaths, but the stems and even the lower spikelets in the ears may also be affected.

Long, narrow, leaden-coloured stripes appear in the leaves running parallel with the veins (Fig. 3). These stripes are often raised above the general leaf surface and as the plants mature, they may burst and expose a black sooty mass of fungus spores.

Flag smut affected plants are often badly stunted, twisted and malformed (Fig. 4).

During harvesting operations, diseased plants are broken up and some of the fine spore dust which is released falls to the ground and some adheres to the grain.

From the control aspect, the life history of flag smut is similar, in all but one important respect, to covered smut or bunt of wheat. Both diseases may be caused by the planting of contaminated seed harvested from affected crops, but, in addition, flag smut spores which fall to the ground may remain alive for several years and contaminate the soil.

Fig. 4.—Wheat plants affected with flag smut. Stunting of plants, and twisting and malformation of the flag are commonly caused by the disease.
(After Simmonds.)

Thus, while seed treatment with an effective fungicide is very useful in guarding against the spread of the disease to new areas, it may not prevent infection from spores present in contaminated soil.

Control:

During the last 20 or 25 years the incidence of flag smut has decreased very considerably. Although the disease is still observed in the field each year, it is generally seen now in trace amounts only. Factors largely responsible for this decrease include, first and foremost, the wide use of flag smut resistant varieties, and secondly, the general practice of dry-pickling of seed wheat with copper dusts, which are effective against flag smut

Fig. 5.—Loose smut of oats (at left) and covered smut of oats (at right).

spores carried on the seed. Unfortunately however, aproximately 20 per cent. of our wheat acreage is still planted to susceptible varieties (chiefly Gabo and Gluclub) and in some instances seed treatment has been either neglected or inadequately carried out. As a result crops are still sometimes noticed in which flag smut is taking serious toll.

In some countries, the flag smut fungus has evolved new races each of which can attack different varieties. As far as is known, the fungus has remained stable in Australia and thus old resistant varieties such as Nabawa still maintain resistance to the disease. However, we should not become too complacent on this account, for it is uncertain whether this position will continue or whether it will change due to the production here of new and more virulent races.

It seems logical to believe that the latter will be less likely to occur if the fungus is kept under subjection, than if it is allowed to multiply, and for this reason measures for the control of flag smut should be constantly applied.

The main measures for the control of the flag smut disease include:—

1. Plant resistant varieties. For many years now resistance to flag smut has been one of the qualities required in wheats bred by the W.A. Department of Agriculture. The disease reaction of the more important varieties as shown by experiments conducted by officers of the Wheat Branch is as follows:—

Highly Resistant:
Nabawa, Eureka II, Festival, Koorda, Warigo.

Resistant:
Bencubbin, Bencubbin 48, Bungulla, Dowerin, Javelin 48, Kondut, Panther, Wongoondy.

Susceptible:
Gabo, Gluclub, Insignia, Ranee, Regalia, Bluclub, Noongaar, Merredin, Gluyas Early.

Fig. 6.—At left, loose smut of barley, and at right, covered smut of barley. The latter disease is much more prevalent than the former in this State.

2. Dry-pickle seed wheat and especially flag smut susceptible varieties with a fungicidal dust which will kill both flag smut and bunt spores that may be carried on the seed. Copper and mercury dusts meet this specification but Hexachlorbenzene (H.C.B.) does not (see Table 1).

3. As flag smut only attacks wheat a rotation with other crops for at least four years will help to reduce flag smut inoculum in the soil.

Also if both flag smut resistant and susceptible varieties are being grown, plant the susceptible varieties on land formerly cropped to resistant kinds.

OAT SMUTS

Two head smuts of oats occur in Western Australia namely loose smut caused by the fungus *Ustilago avenae* and covered smut caused by *Ustilago kolleri* (Fig. 5).

TABLE 1.

SHOWING PERCENTAGE OF FLAG SMUT INFECTED WHEAT PLANTS GROWN FROM SEED INOCULATED WITH FLAG SMUT SPORES AND TREATED WITH FUNGICIDES AT WONGAN HILLS AND MERREDIN RESEARCH STATIONS, 1953:—

Treatments.	Percentage Flag Smutted Plants.	
	Wongan Hills.	Merredin.
1. Clean seed untreated	0.17	0.2
2. Seed smutted 1:150	23.58	23.46
3. Seed smutted and dusted with copper carbonate 2 oz. per bush.	0.88	0.2
4. Seed smutted and dusted with organic mercury compound, 2 oz. per bush.	0.53	0.36
5. Seed smutted and dusted with 20 per cent. H.C.B. compound 2 oz. per bush.	24.18	18.85
Difference for significance at 99:1 level	7.65	3.05

Fortunately, both cause infection at the seedling stage due to the planting of smut-contaminated grain, and are therefore controlled by the same method of seed treatment.

Formerly these diseases were held in check by disinfecting the seed with formalin solution, but although this method was very effective, it was laborious and prone to damage the grain.

Good control of oat smuts may be obtained by thoroughly dusting the seed with organic mercury dusts at the rate of 2-3 oz. per bushel and this is now the standard method of treatment in W.A.

It should be noted that copper carbonate is not recommended for controlling the oat smuts.

BARLEY SMUTS

Covered smut of barley caused by the fungus *Ustilago hordei* is the most prevalent smut disease of this cereal in Western Australia. The smut masses which replace the grain and glumes in affected ears remain enclosed within a membrane, until harvesting takes place, when they are broken up and the spore dust thus released contaminates the healthy grain (Fig. 6).

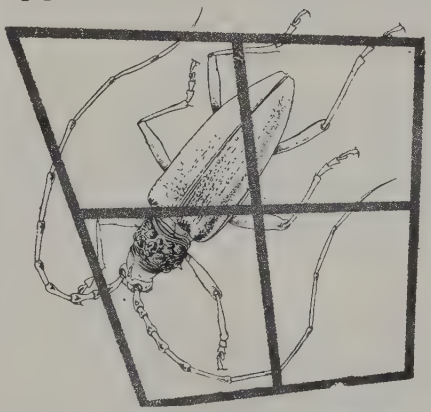
Covered smut of barley may be controlled by thoroughly dusting the seed with organic mercury compounds in a similar manner to the oat smuts. A formalin method of disinfection is also available but this is seldom used.

Loose smut of barley caused by the fungus *Ustilago nuda* occurs here in trace amounts, but there are some indications that it is increasing.

The powdery spore masses which appear in affected ears are gradually blown away by wind, until at harvest time the stalk of the ear is more or less bare (Fig. 6). Infection occurs at the flowering stage in a manner resembling loose smut of wheat, and for this reason dusting the seed with fungicides is not satisfactory.

Farmers who see much smut in barley crops grown from seed thoroughly pickled with organic mercury dusts, are asked to submit specimens for identification, for if loose smut becomes prevalent healthy seed must be obtained from research stations or clean crops in the district.

There are no rotten metal windows



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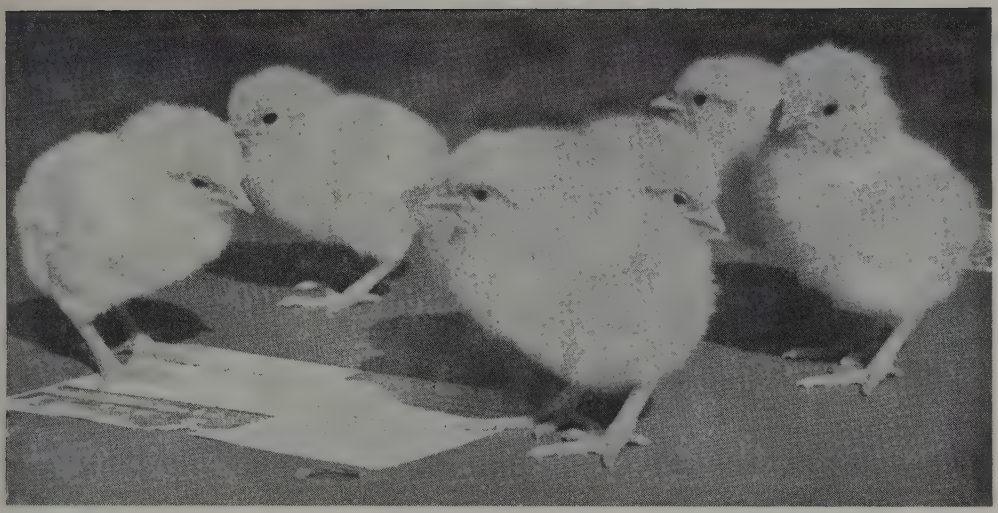


THE CARE OF CHICKENS

By R. H. MORRIS, B.Sc. (Agric.), Officer-in-Charge, Poultry Branch.
and L. J. GAFFNEY, B.Sc. (Agric.), Poultry Adviser.

THE purpose of this article is to provide purchasers of young chickens with an outline of the procedures and problems associated with successful chicken raising, and perhaps to serve as a reminder to those poultry farmers who already have a good knowledge of the subject. The wide range of subject matter has made it necessary to present much of the material in a condensed form, and reference should be made to various departmental leaflets for an elaboration of many of the points mentioned in this article. The advisory service of the Department of Agriculture, Poultry Branch, is available to poultry farmers seeking information. Instruction on all matters relating to poultry husbandry will be freely given and visits to farms by field officers can be arranged.

Knowing how to rear chickens properly is the basis of successful poultry farming. It should always be remembered that the commercial chick is denied the maternal influence and depends entirely on artificial conditions for its well-being. It is the chicken's birthright to develop a sound, healthy body and eventually to lay an abundance of eggs or to produce a good carcass.

Although the majority of chickens in this State are reared correctly, each year sees the future of many thousands of our chickens spoilt during their early life owing to unfavourable environmental conditions, incorrect feeding and management.

Mismanagement in the crucial stages of growth and development is closely linked with poor productivity in later life. Provided that chickens are given a good start, they soon become hardy and self-reliant and need little attention beyond routine management, good housing and feeding. It is hoped that the advice given here will assist in reducing to a minimum the wastage of stock, time and money incurred through poor rearing practices.

THE BROODER HOUSE

The brooder house should be designed for protection against rain, cold and draughts and should retain heat within its walls with reasonable efficiency. As-

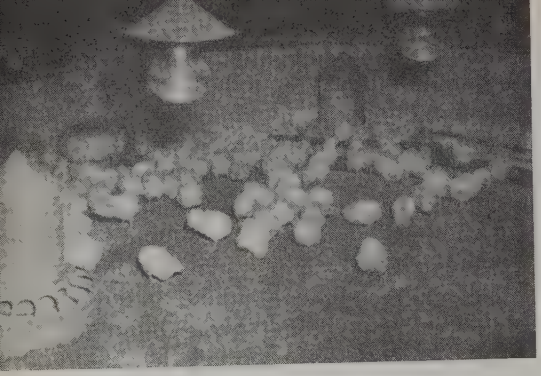


Fig. 1.—Brooding chickens under infra-red ray lamps. Two lamps are used to brood 200 chickens. The dry mash feed hoppers and troughs and watering fonts are placed inside the ring of flat iron which is used to keep the chickens near the source of heat until they become brooder-wise. The guard also protects the chickens from ground draughts. Note the sawdust litter on the floor of the compartment.

bestos is the most popular insulating material used for a brooder house, and sometimes the interior of the building is lined to retain warmth. Brick brooder houses also provide good insulation.

The brooding compartment should be well covered-in, particularly on cold nights, but ventilation is necessary at all times. Combustion fumes rising from certain types of brooders must have an outlet from the brooder house either at the top of the wall or through the roof, otherwise the brooder house may be filled with injurious gases.

Sunlight brings warmth and cheer into the house and as much as possible should reach the floor of the brooder compartment. Sections of the front and back walls should be fitted with glass louvres or other material for admitting sunlight. The wall facing away from the weather—usually the eastern wall in this State—should be well supplied with lighting and ventilation.

PREPARING THE BROODING COMPARTMENT

The compartment should be prepared several weeks before the chicks are introduced. Three to four inches of perfectly dry litter material, usually clean red sawdust or wood shavings, is placed on the concrete floor. Where there is a degree of fire risk—as in the case of charcoal brooders—a layer of dry sand could be used extending about nine inches out from the brooder.

The brooder is set in operation a day or so before the chicks are received, to warm up the litter and the surrounding atmosphere and to test the working efficiency of the brooder. A low wall of flat iron approximately 18 in. high is placed around the brooder in a circle at a distance of from 2 ft. 6 in. to 3 ft. 6 in. from the source of heat, depending on the amount of heat generated. When a hover type brooder is used the wall should be placed about a foot away from the edge of the hover and the circle enlarged as the chicks become brooder-wise. The guard ring prevents the day-old chicks from straying too far from the brooder and also shelters them from floor draughts. When the chicks are three to four days old, the area enclosed by the circle is further increased and usually by the end of the first week the iron is used only to round off the corners of the compartment to prevent the chicks from crowding into the angles of the wall and suffocating.

It is usually necessary to cover in any open parts of the walls or compartment partitions with hessian bagging or similar material to keep the compartment snug and warm. This applies particularly in the early stages of brooding and during the night. During the warm periods of the day, however, the compartment should be opened up to let in as much direct sunlight as possible.

BROODER HOUSE EQUIPMENT

Brooder

The type of brooder used is not important provided it produces adequate heat.

Make frequent observations of the behaviour of the chickens to determine if a comfortable brooding temperature is being maintained. If they are spread evenly around or under the brooder they are comfortable. If they huddle close to the source of heat, they are too cold; if they press hard against the guard wall they are too hot. Make sure that the chickens are eating and drinking at the proper times. Check their behaviour about 6 a.m. when the lowest atmospheric temperatures are reached, as that is when most chilling occurs.

Various brooding systems are used according to the convenience of operation, the type of housing, and the size of the unit. The most commonly-used floor brooders in this State are kerosene burners, infra-red ray lamps, electric, charcoal and hot water brooders.

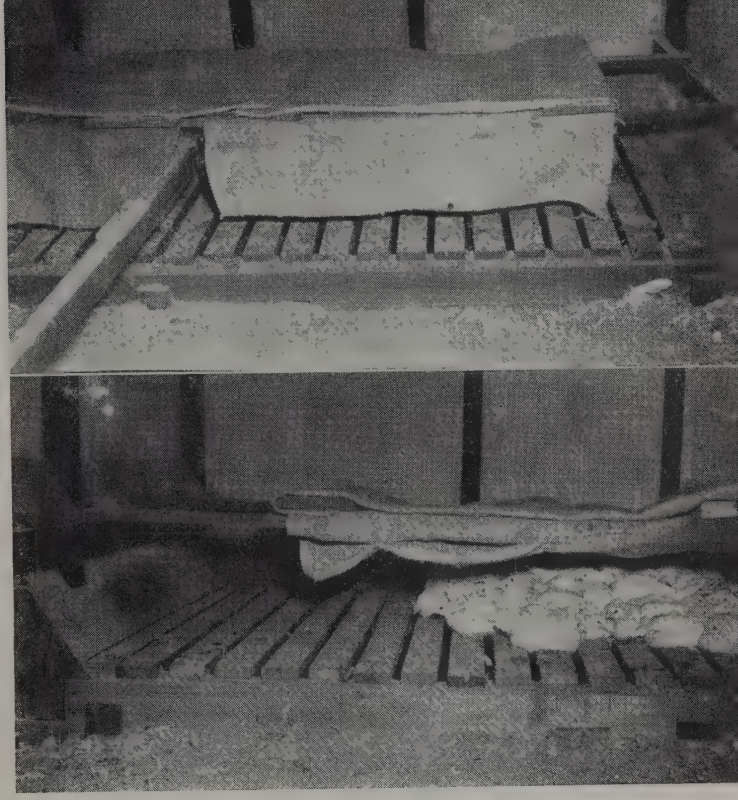


Fig. 2.—A batch of six-weeks-old chickens is snugly bedded down for the night behind the bagging curtain shown in the top picture. The bags which form a cold brooder, are attached to the permanent perches installed 12 in. above the platform. The bags forming the roof extend to within 18 in. of the sides of the shed and 9 in. of the back wall. The hanging curtain is 2 in. to 3 in. from the platform.

(Below)—By lifting the front bag, half of the chickens may be seen in position. Note how they occupy the central portion of the platform. By appropriately arranging the bags, the chickens may be effectively discouraged from crowding into the corners of the platform or on to the back protective board. Note the sloping protective boards at each side of the platform.

At seven weeks of age the top bags will be removed, and the front bags will be taken away a week later.

Kerosene Brooders:

It is important to check the temperature of the brooder at a point 2 in. above the surface of the litter and midway between the source of heat and the outside edge of the hover. The thermometer should record 95°F. to 100°F. for the first three weeks and thereafter the temperature can be decreased by 5° to 10°F. each week until the heat is dispensed with at five or six weeks of age. To avoid explosions, the bowl of the lamp should never be more than three-quarters full of kerosene. Fumes from the burner must have an outlet at the top of the compartment.

Infra-Red Ray Lamps:

Where infra-red ray lamps are used, it is a good idea to light and hang a hurricane lantern in the brooding compartment in case of a power breakdown. This prevents any undue panic which may occur if the brooder house is suddenly plunged into darkness.

It may be necessary to lower the infra-red ray lamp to a height of 10 in. above the litter in order to obtain sufficient heat. Usually however, the bottom of the lamp is placed 12 in. to 14 in. from the surface of the litter and, should insufficient

Fig. 3.—A rearing shed with asbestos-cement roof and walls and divided into two compartments each measuring 12 ft. x 12 ft. The front of the shed faces east and the bottom half of the front wall is covered to a height of 4 ft. The compartments can be made snug for brooding purposes by covering the top half of the front wall with a sacking blind. Note the ramp at the foot of the doorway to each compartment. This is designed to eliminate sharp corners at the doorway where the chickens would be liable to crowd.

warmth be derived when the lamp is lowered to 10 in., another form of brooding is called for, as the voltage is insufficient for infra-red ray brooding. One lamp is used to accommodate a maximum of 100 chicks. To achieve success with this system, a warm, snug brooding compartment and a 4 in. depth of dry sawdust or wood shavings are required.

Charcoal Brooders:

Charcoal brooders generally supply an abundance of heat, and are ideal for use where the brooder house is spacious and not very well insulated. Wood-burning, 44-gallon drum type brooders are popular in the country and achieve good results because of the abundance of heat which they generate.

Hot Water Pipe Brooders:

These brooders are commonly used where a large number of chickens are reared. The initial cost of installation is relatively high but running costs are low.

Feeders.

For the first few days, the feed is placed in shallow trays so that the chicks have little trouble in finding it. Some mash may be scratched onto the litter and the attendant must be continuously cleaning out and replenishing the trays, but this is one occasion when feed wastage can be overlooked as the primary object is to get the chicks eating. Within three days the food consumption shows a significant increase and the chicks are ready for trough feeders. A standard type chicken trough 4 in. wide, 2½ in. high, and 2 ft. 7 in. long with a ½ in. lip and an anti-perch roller 1½ in. above the trough can be easily and economically made from a strip of 26-gauge galvanised flat iron measuring 36 in. x 10 in. Wooden troughs of light timber can be similarly constructed. Three troughs of this type would serve 100 chicks to four weeks of age. It will be necessary to sink the bottom of the troughs an inch or so in the litter until the chicks are big enough to reach the mash. As the chicks get older, more trough space should be provided, either by adding more troughs or by using a larger model.

A suitable trough to use during the 5 to 13 week-old stage can be made from a strip of flat iron measuring 6 ft. x 1ft. 6 in. The bottom of the trough is 7½ in. wide, the sides are 4 in. high with 1¼ in. lips (the ¼ in. being turned downwards), and the length is 6 ft. if ends cut from a separate sheet are used.

Pieces of 8-gauge wire or conduit are placed across the trough and spaced 2⅛ in. apart. The wires are pushed through holes drilled in the lip and bent back underneath the lip.

At 13 weeks of age a full-sized trough, suitable also for laying birds, should be provided. This is a slightly larger version of the previous type, the dimensions being: bottom 14 in. wide, sides 6 in. high, lips 2 in., length 6 ft.

Waterers.

Watering fonts for young chickens should be distributed around the perimeter of the area enclosed by the iron guard and in between the feeding troughs. The fonts can be placed on flat boards or wire platforms. This arrangement keeps the drinking water reasonably free from contamination by droppings and litter material, and damp patches of litter around the drinking vessels are avoided. Four fonts will serve 100 chicks up to four weeks of age. A changeover to automatic watering vessels can be made gradually when the

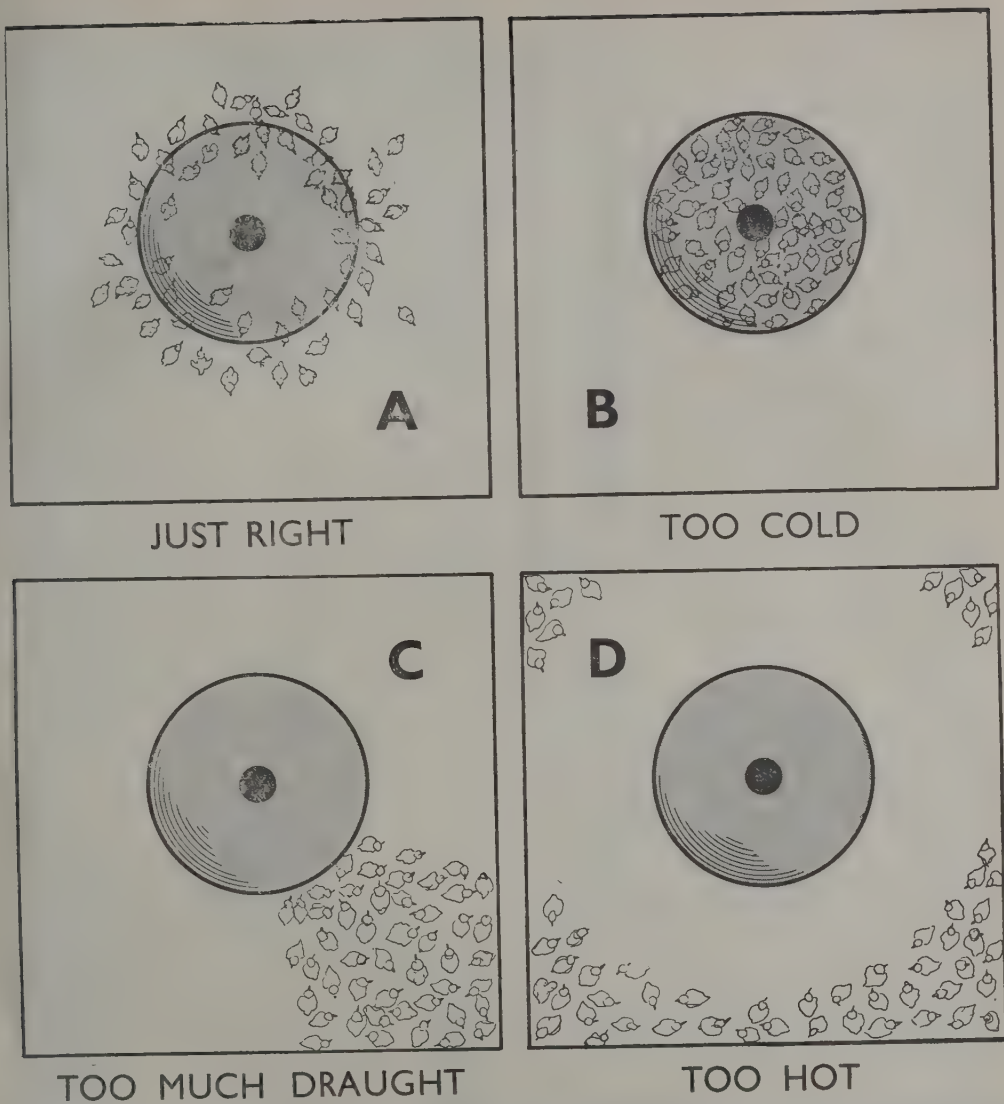


Fig. 4.—YOUR CHICKS CAN TELL YOU IF THE TEMPERATURE IS RIGHT.—The actions of the chicks will soon let you know whether the correct brooder temperature has been achieved. If they are distributed evenly under the hover and at the hover's edge, they are comfortable and happy (A). When they huddle together under the hover (B) they are too cold.

Floor draughts may be suspected when they huddle in a group (C). If they get as far away from the hover as the floor-space allows, (D) the heat is excessive.

chicks are about one week old; the sooner the better, as this will mean a considerable saving in labour. To reach the automatic waterer the chicks should walk over a slatted platform built outside the front wall of the compartment.

SIZE OF UNIT

Usually less trouble arises when chicks are reared in small units. Under average conditions rearing results have favoured units of approximately 150 chicks. Where a large number of chickens are housed

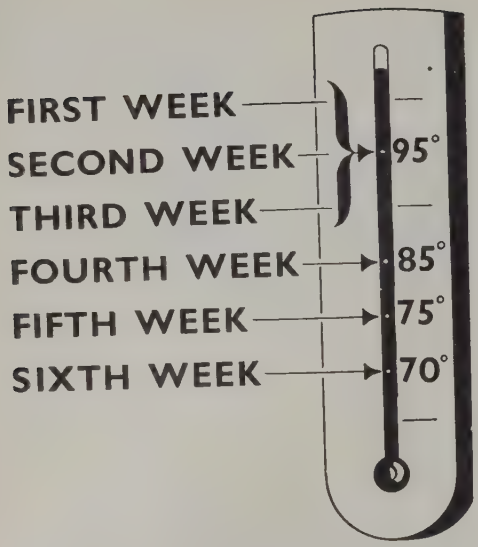


Fig. 5.—The diagram shows suitable hover temperatures for chicks of various ages.

together in one compartment, not only is there a tendency towards overcrowding as the chicks get older, but unless they are subsequently divided into smaller groups, it is very difficult to teach the chickens to perch at an early age. A heavy infestation of coccidiosis is more likely to occur and is more difficult to control in a larger unit, particularly if there is some defect in the management. In fact, most problems associated with chicken rearing are usually accentuated in the larger sized units. Overcrowding of chickens either in the brooding or rearing stages can have disastrous effects and the attendant should keep a check on the amount of space allowed each chicken.

Minimum Shed Floor Space Required Under Semi-intensive Conditions:

0-5 weeks—$\frac{1}{2}$ sq. ft. per chicken.
6-12 weeks—$\frac{3}{4}$ sq. ft. per chicken.
13-20 weeks—$1\frac{1}{4}$ sq. ft. per chicken (plus free range).

Minimum Feeding Space for All Dry Mash Feeding:

1-4 weeks—12 ft. per 100 chickens.
5-10 weeks—16 ft. per 100 chickens.
11-20 weeks—24 ft. per 100 chickens.
Laying birds—30 ft. per 100 birds.

Minimum Watering Space:

1-4 weeks—4 fonts per 100 chickens.
5-20 weeks—2-3 ft. per 100 chickens.
Laying birds—4 ft. per 100 birds.

Perching Space:

As the chickens become older and more perching space is required, extra perches are provided.

9-12 weeks—35 linear ft. per 100 chickens.

13-20 weeks—40-50 linear ft. per 100 chickens.

FEEDING

During the first 24 hours after hatching the chicks' main requirements are warmth and drinking water. After this time, a small amount of "starter" chick mash containing a minimum of 16 per cent. crude protein should be provided, first on paper and then in shallow trays placed in close proximity to the brooder. Within three to four days, the mash troughs previously described can be introduced. Chickens should never be without food.

A minimum of 16 per cent. crude protein is required in the diet for the first seven weeks. From 8-12 weeks a level of

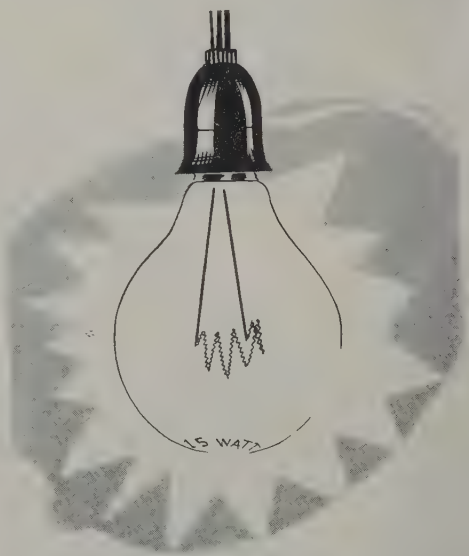


Fig. 6.—A small 15-watt globe placed above the hover and switched on at night will help to prevent chicks from crowding. After the birds learn to perch, the light is no longer necessary.

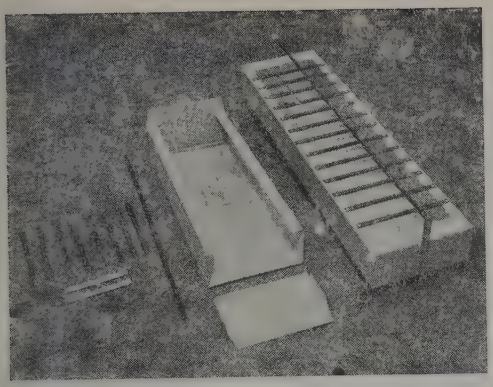


Fig. 7.—A dry mash feeding trough 14 in. wide and suitable for chickens 13 weeks of age and older, or for laying birds, is illustrated above. Lengths of $\frac{3}{4}$ in. conduit 13½ in. long are bolted to the lips of the trough. The anti-perch roller consists of a 6 ft. length of conduit with a piece of heavy gauge plain wire running through it. (See text).

15 per cent. protein is fed, this being reduced to a 14 per cent. level at 13 weeks. The protein remains constant at 14 per cent. from 13 weeks until the pullets lay their first egg, at which time the protein should be increased to a 16 per cent. level. A good flock of first-cross pullets will commence laying when 20 weeks of age.

Buttermilk powder, because of its relatively high protein and riboflavine content, is an excellent foodstuff for chickens and a 4 per cent. level in the ration is recommended until the chickens are six weeks old. From this time, to reduce feeding costs, the quantity of buttermilk in the ration is gradually decreased until it is excluded at the twelve week-old stage.

Note: Ration No. 5 can be used when mill offal is scarce. Barley can be substituted for part of the wheat and oats in the above rations on a pound for pound basis. Whalemeal can be substituted for meatmeal on the basis of 5 lb. of whalemeal for 6 lb. of meatmeal.

If whole grain is fed in addition to these mashes, extra meatmeal must be included in the mash.

Chicken Ration 8-12 Weeks:

In each of the above rations reduce both the buttermilk powder and the meatmeal by 2 lb.

Growers Ration (13 weeks to point of lay):

In each of the chick mashes listed above omit the 4 lb. of buttermilk powder and reduce the meatmeal by 3 lb.

It is essential that vitamins A and D_3 be included in the mash at the correct level. Normally vitamin D_3 can be omitted from the ration after the first 4-6 weeks but a vitamin A supplement should be fed in the mash continuously. The inclusion of antibiotics in the "starter" chick mash can be beneficial.

Natural herbage or chopped-up, succulent greenfeeds such as lucerne, kikuyu grass or cereals should be provided from one week of age onwards.

One-eighth "all-in" metal dust placed in a shallow, easily-accessible trough in the brooder compartment will enable a better utilisation of food by the chicken by helping the gizzard to work more effi-

ALL MASH RATIONS

Chicks 0-7 Weeks

	lb.	lb.	lb.	lb.	lb.
Flaky bran	25	30	15	20	10
Pollard	20	16	15	10	5
Wheatmeal (coarsely gristed)	28	30	40	40	35
Gristed oats (very finely gristed)	10	10	15	15	10
Meatmeal (50 per cent protein)	9	10	10	10	9
Buttermilk powder	4	4	4	4	4
Bonemeal	1	1	1¼	1¼	1
	97	101	100¼	100¼	74

Fig. 8.—An even group of growing pullets ranging on natural herbage. Well-grassed range is most beneficial for developing healthy robust bodies. Grading is a "must" in successful chicken rearing.

ciently. A change to one-eighth screened metal dust can be made when the chicks are ten weeks old as by this time the larger grit particles will prove more beneficial. More detailed feeding information will be found in Departmental Leaflet No. 995.

LITTER MANAGEMENT

After the first two or three days of brooding, the litter underneath the brooder should be inspected and if there are signs of dampness or droppings accumulating on the surface, a light application of hydrated lime followed by forking-in will maintain the litter in a dry state. It may be necessary to replace the damp litter underneath the brooder with dry material from another area of the compartment. It is essential that a dry litter be maintained at all times.

TEACHING CHICKENS TO PERCH

The transition period from floor brooding to perching is a vital phase in the chick's life and can be a strenuous and exasperating period for the farmer. Mismanagement at this crucial stage is, in many instances, the underlying cause of poor results later on.

The problem should be approached methodically to achieve success with a minimum of effort. The procedure of teaching chicks to perch with the aid of a perching platform is contained in a Departmental leaflet on this subject.

LETTING THE CHICKENS OUTDOORS

When 10 to 14 days old, depending on the weather, the chicks are allowed out into a small run for a few hours after 10 a.m. on a warm, sunny day The period is extended as the birds become hardier and more vigorous until by about three weeks of age the door to the run is left open all day, providing the weather is not too boisterous.

Fresh ground planted to a green crop such as rape should be provided for the young chicks. At first, most of the run is hurdled off so that the chicks are allowed only a small area. As they become older and more vigorous the area is increased by shifting the hurdle further back. In this way, the chicks are given access to a fresh area of greenfeed each time the hurdle is moved. Usually about five square feet of run is allowed each chicken up to nine weeks of age, when the gates to the runs are opened and the birds are free-ranged on open grassland. Free range not only provides natural nourishment to the stock but also enables the growing birds to develop healthy robust bodies. Bare ground provides little benefit to the chickens. As a guide, about 500 growing stock up to the laying stage can be ranged on an acre of land.

GRADING YOUNG STOCK

It is necessary to grade young stock in order to obtain a harmonious relationship between individuals in a group. Variations in body size and vigour soon become apparent in growing stock and differences in social status are established.

Unless the flock is graded into equal class groups, the slow-developing individuals are unable to compete against, and are eventually oppressed by, the more advanced chickens. At the six-week old stage it is not unusual to have a certain number of backward chickens in the flock, but this does not necessarily signify a fault in management as differences in growth rate and development can be expected in most flocks.

However, to avoid retarding the development of these birds it is essential to segre-

gate them from the flock and the importance of this management practice cannot be over-emphasised.

When housed as a separate group, the backward chickens appreciate the freedom from interference by the more advanced birds and within a few weeks their development is noticeably improved—indeed in many cases where grading is carried out early in life, the backward birds soon catch up to their more advanced companions. The free ranging of young stock reduces bullying or "bossism" to a minimum thus promoting even development.

The flock should be graded before being housed in the laying quarters as marked differences in the rate of sexual development frequently exist between individuals.

The practice of grading the birds according to precociousness contributes greatly towards reducing the number of culls which subsequently develop in the laying flock.

CHICKEN AILMENTS

Omphalitis (or Navel Infection).

This disease is sometimes encountered in very young chicks with most losses occurring during the first three to four days of brooding The ailment frequently originates in the hatchery. It occurs when the navel opening does not heal properly and infection of the navel and yolk sac results, more generally under unsanitary conditions. Affected chicks are drowsy, the abdomen is puffed or mushy and there may be inflammation around the navel. A post mortem examination generally shows an abnormal yolk sac containing more fluid than usual with a putrid odour. There is no treatment for affected chickens, but the infection can usually be controlled by exercising strict sanitation in the incubator and hatchery. Although omphalitis in young chickens is fairly widespread, losses through the disease are not heavy.

Fig. 9.—A bad case of coccidiosis—number one chicken killer. Note the droopy appearance and the dead chickens. Serious losses can be avoided by proper handling and treatment.

New drugs have come to the assistance of the poultry farmer in combatting coccidiosis. Nitrofurazone or sulphaquinoxaline administered through the drinking water as recommended by the manufacturers usually achieve excellent curative results.

Affected chickens should be kept warm. The caecal form of the disease frequently strikes when the chickens are about to be weaned from artificial heat and in such circumstances the brooder can well be used for a further week or ten days until the attack has subsided. Heavy mortalities are more likely to occur if the chickens are allowed to crowd in corners during the night. A perching platform and night lighting will prove of assistance under these conditions.

IT TAKES ALL THREE TO PRODUCE GOOD EGG-LAYERS

Pullorum Disease.

At one time this was a very prevalent disease of young chickens, being transmitted from parent stock to the progeny through the hatching egg. By using hatching eggs obtained from pullorum-free breeding stock the incidence of the disease in chickens has been reduced to negligible proportions in this State. Most deaths occur during the first 14 days, and losses are usually heaviest about the fourth or fifth day. The birds appear dull and listless, have drooping wings and they do not feed or drink. In a number of cases a white diarrhoea frequently pastes up the vent.

Chilling.

The external appearance of chilled chickens closely resembles that shown by those affected with pullorum disease, but chilling is a far more common cause of chick losses than pullorum disease. Regular attention should be given to the warmth provided by the brooder and should losses occur, a check on the chickens' behaviour should be made during the early hours of the morning before a complaint is lodged with the supplier of the chickens.

Crazy Chick Disease.

This is an abnormality of individual chicks, the cause of which has not been determined but it appears to be associated with the nervous system. The chick behaves in a convulsive manner, frequently throwing back its head, stumbling and displaying other queer antics. Some birds make a normal recovery. Usually the biggest chickens in the batch are affected and the condition clears up itself within two weeks of first coming under notice.

Coccidiosis.

The most prevalent disease of chickens in W.A. There are two forms of the disease, both having characteristic symptoms

Cæcal Form: Outbreaks occur mostly during the brooding period and frequently when the chicks are four to eight weeks of age. The external symptoms are a dejected huddled appearance, feathers ruffled, wings drooped, blood passed in the droppings. An internal examination usually shows the cæca to be filled with blood. Usually, varying degrees of infection are evident.

Intestinal Form: Often occurs as a secondary outbreak at a later stage, usually when the chickens are 8 to 14 weeks of age. Although the entire group may be affected, it is frequently confined to a small proportion of the chickens. The outward symptoms are similar to those due to cæcal coccidiosis except that blood seldom appears in the droppings.

Prevention: Keep a strict check on sanitation, particularly by maintaining a dry litter, as this will greatly assist the chickens to build up a natural immunity or resistance against an outbreak of the disease. The damp soil outside provides an ideal source of infection but if hygienic runs are provided, these will help minimise the extent of infection.

Cure.—Treatment with either sulphaquinoxaline or nitrofurazone in the drinking water is a very effective cure, providing the treatment is commenced as soon as the symptoms are sufficiently specific to diagnose the disease. The directions for using these medicines should be closely

adhered to. Having cured the disease, Lugol's solution may be found helpful in returning the chickens to a really robust state of health. Lugol's solution consists of two ounces of potassium iodide and one ounce of iodine crystals dissolved in one pint of water. This stock solution is added to the drinking water at the rate of one teaspoonful to each gallon of drinking water. Lugol's solution can be given for one fortnight immediately following the treatment with sulphaquinoxaline or nitrofurazone.

Vitamin A Deficiency.

The condition is commonly referred to as nutritional roup. Where a vitamin-A-rich supplement is included in the ration at the required level this deficiency should never arise. Fish oils used as a vitamin A supplement should be fresh and should not be fed through the drinking water as their potency is considerably reduced on exposure to air. During the brooding period a vitamin A and D_3 supplement should be fed, as the chickens receive only a limited amount of direct sunlight while in the brooder house. A deficiency of vitamin A predisposes the stock to other maladies such as worm infestation, chicken pox, coryza, etc.

Leg Weaknesses.

Specific leg weaknesses must be distinguished from leg weaknesses often associated with the diseases already mentioned. Some forms are due to a mineral or a vitamin deficiency in the diet or to the inability of individual birds to assimilate these nutrients. Rickets, curl toe paralysis, and leg weaknesses caused by a dietary deficiency or an unbalanced supply of minerals required for bone formation are dealt with in Departmental Leaflet No. 995 entitled "Nutritional Requirements of the Domestic Fowl."

Leucosis.—One form of leucosis known as fowl paralysis is typified by lameness and frequently occurs in growing stock approaching the lay. Affected birds, which may in other respects look well-grown and healthy, lose the use of one and sometimes both legs and the toes become folded in.

The disease is believed to be caused by a virus but there is no curative treatment. Preventive measures revolve principally around sanitation and the strict isolation of young chickens from adult birds.

Tick Fever.—This is another disease of growing and adult birds causing leg paralysis. It is often not realised that the birds are ailing until they suddenly lose the use of their legs. Before this happens certain symptoms may be observed, namely, loss of appetite, feverishness, a darkening of the tips of the comb and the voiding of a bright green-coloured or sometimes whitish droppings. Death may ensue within a few days of the appearance of these symptoms, but such birds as recover acquire a degree of immunity against the disease.

Tick fever is caused by a parasitic organism transmitted by both poultry tick and red mite. Control of these two pests will prevent the spread of the disease through the flock. (See Departmental leaflet for control measures.)

Worm Infestation.

The intestinal round worm is the most common type of worm affecting poultry flocks in this State. Serious infestations are usually apparent late in the growing stage and often when the pullets approach the lay.

Prevention and Control Measures.—Provide chickens with fresh ground which has been exposed to the hot sun, well

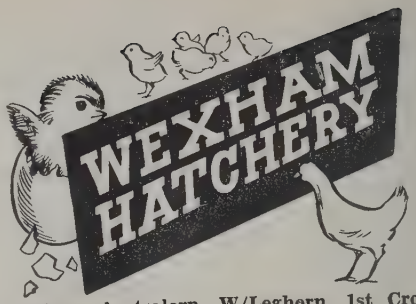
Fig. 10.—The reward of good chick rearing.

limed and planted to crop. Avoid damp litter, particularly around waterers. Routine deworming of the young stock at ten weeks and again at eighteen weeks of age is strongly recommended, preferably by drenching with carbon tetrachloride or, where only a small number of birds are kept, by using deworming capsules.

Chicken Pox.

This is another prevalent disease of poultry, outbreaks being more frequent in young stock from about 16 weeks of age onwards. Sanitation and purchasing chickens "in season" usually prevent the disease occurring before the birds are old enough for vaccination. All young stock should be vaccinated at 12 weeks of age and certainly not later than 16 weeks of age.

For success with chickens none of the measures recommended above should be neglected whether the number of chickens being reared is large or small. A little extra care and trouble taken to follow these instructions will be amply repaid, for a good start is more than half the battle.



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INSECT Pests AND THEIR CONTROL

By D. G. SHEDLEY,, B.Sc. (Agric.), Entomologist.

NEW INSECTICIDES AND FRUIT FLY CONTROL

DESPITE the increasing number of new insecticides and techniques which are being developed, the Mediterranean fruit fly (Ceratitis capitata) continues to be one of the most serious pests of the fruit industry in this State.

Community baiting schemes have been inaugurated in several districts and have shown their worth in keeping this pest to a minimum. Nevertheless fruit fly still abounds in the West Coastal and Hills fruit-growing districts. It has been felt that one or more of the new developments should be applicable to fruit fly control, and may overcome some of the limitations of the strict hygiene and sodium fluosilicate foliage baiting which has been made a compulsory measure to combat the pest.

Parathion, H.E.T.P., DDT, BHC, aldrin, dieldrin and chlordane have been used in baits and DDT, BHC, aldrin, dieldrin and chlordane as ground dressings in laboratory and field tests but no means of control superior to the present recommendation has yet been achieved. An earlier report (Ryan, 1950) has dealt with trials concluded during or before 1950.

BAITING TRIALS

Poisoned sugar syrup splashed onto the foliage has been the basis of the method recommended for controlling fruit flies in W.A. for a number of years. Sodium fluosilicate was early shown to be an efficient poison and has proved satisfactory when properly used in conjunction with practices such as early picking of fruit, regular picking up of fallen fruit and the proper destruction of any fruit suspected of being infested. This bait (1 oz. of sodium fluosilicate plus 2½ lb. sugar in 4 gallons of water) has been used as the standard with which to compare other baits. Sugar concentrations in all baits have been left constant.

BHC showed immediate promise but after a number of trials it became apparent that results from cage baiting trials were being marred by a high mortality due to the fumigatory action of the BHC.

Fig. 1.—Adult female of the Mediterranean fruit fly (greatly enlarged).

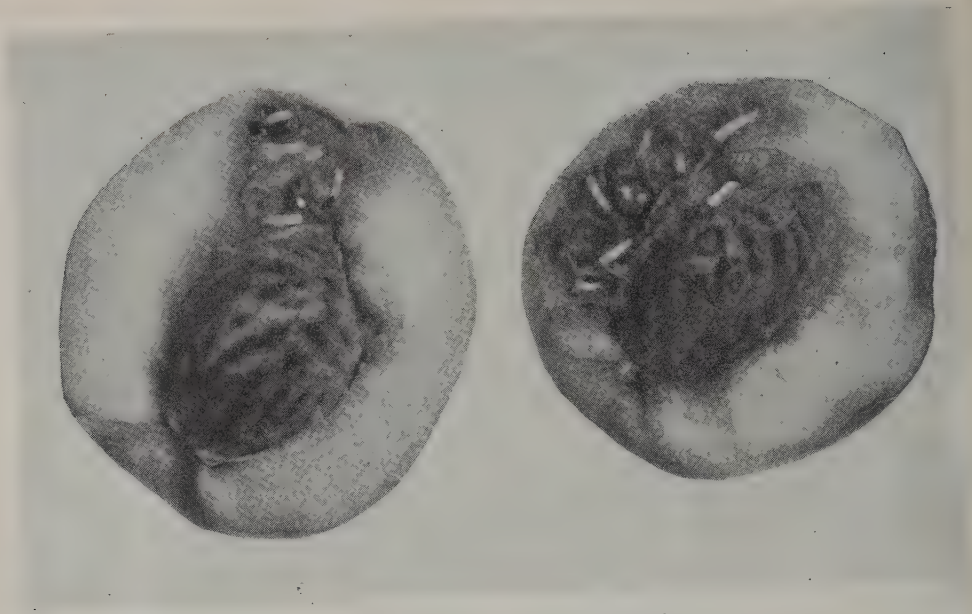

Fig. 2.—Peaches showing typical fruit fly damage.

This effect would be greater in confined spaces, such as are necessary in laboratory trials, than would occur in the field and hence an endeavour was made to ascertain the proportion killed by fumigation. Two cages were baited with a BHC bait which was available to the flies; two were treated with the same material but with the bait covered by a wire gauze to prevent contact or feeding; two cages were kept as controls with no insecticide present. The time taken for 50% of the flies to die was—

Open bait	17 hours
Covered bait	32 hours
Control	96 hours

A small-scale field trial in which BHC was compared with sodium fluosilicate showed, by the number of flies dead under the trees, that the rapid killing action of a BHC bait was not confined to the laboratory.

In an experiment carried out on Valencia oranges, in which BHC was compared with sodium fluosilicate, the efficiency of both insecticides in a bait and the superiority of sodium fluosilicate over BHC were demonstrated. Lindane, the pure gamma isomer of BHC, was used in later trials in conjunction with the more recent insecticides.

DDT, Parathion and H.E.T.P. were shown to be less effective than BHC in early trials and were discarded in favour of more extensive tests with this insecticide.

Chlordane, Aldrin and Dieldrin were the subject of more recent exploratory cage baiting trials. As in trials using other insecticides, the bait was smeared onto a glass plate which was introduced into the test cage.

Indications from the trials were that these materials were no more effective and no more rapid in action than the standard bait when used at comparable concentrations. Aldrin, at higher concentrations, killed the flies more rapidly. This, as in the case of BHC, was probably due to a fumigatory action.

SOIL DRESSINGS

Soil dressings have been investigated because it has been felt that a susceptible stage in the life of the fruit fly is the time when the larva leaves the fruit to pupate in the soil.

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Although in some cases quite good results have been achieved, no treatment appeared obviously superior to the foliage baiting when efficiency and cost were both considered.

BHC again showed promise and has been used in a number of laboratory experiments. In this also the fumigatory action in the laboratory has made results difficult to interpret.

At the rate of 19 lb. of 10% BHC per acre, only a few flies emerged and none of these survived for more than one hour. Most larvae dropping onto treated soil either died before pupation or formed distorted pupae which failed to develop. Others perished at or soon after emergence of the adult fly. Toxicity was shown to remain for at least a period of 4-5 months.

To simulate field conditions, an experiment was carried out on a small plot of land on which fly wire cages were placed over areas of treated soil. Reasonable control seems to have been obtained from a concentration of 1¼ lb. of gamma isomer BHC per acre.

DDT soon proved to be inferior to BHC and hence was discarded in its favour.

Chlordane, Aldrin and Dieldrin were tested against BHC in the laboratory. Chlordane gave disappointing results. Aldrin and dieldrin had comparable effects on the larval stage. Aldrin caused a higher mortality of emerging flies, but was still inferior to BHC in total kill. Concentrations used were approximately 4 lb. of active ingredient per acre applied in an emulsion to wet the soil in the test tray.

ACKNOWLEDGMENTS

The work here reported has been carried out under the direction of the Government Entomologist (Mr. C. F. H. Jenkins) for which acknowledgment is given. The author also wishes to thank Mr. F. E. Ryan, previously of the Entomology Branch, for permitting the use of some unpublished material.

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The Cultivation of Chrysanthemums

By C. C. HILLARY.

Fig. 1.—A typical medium-sized decorative Chrysanthemum

IN a land such as this where roses, dahlias, zinnias and asters flower so generously in the autumn, the chrysanthemum does not, perhaps, command quite the same affection as it does in colder countries where it is almost invariably the autumn flower supreme.

Nevertheless, with its various forms, splendid colours and long-lasting qualities, the chrysanthemum still retains a considerable popularity and a popularity which is again increasing. The most widely-grown type of chrysanthemum in this State is that known as the single, but the anemone-flowered, the large and medium-sized decoratives and the large Japanese incurves are all being cultivated in increasing numbers.

All kinds are easy to grow and all are easy to propagate. There are two ways of raising new plants—from cuttings, and by dividing and replanting portions of the old stools. It is generally accepted that cuttings always produce the best plants.

PROPAGATION BY CUTTINGS

Cuttings may be raised at any time during September and October for transplanting in November and December. Only plants which produced satisfactory flowers during the previous season and are in a thoroughly healthy condition should be used for propagation.

Cuttings taken from the growths appearing at the base of the old stools (see drawing) are preferable to those produced on the stems, although in the case of varieties that fail to make sufficient basal growths, there is no option but to take stem cuttings. When this has to be done, the lower ones should be selected.

Fig. 2.—Clump as lifted showing basal shoots from which the cuttings are taken.

The type of cuttings which make the best plants are those of moderate thickness and preferably of a wiry nature. Large, thick, soft cuttings rarely make good plants. Some days before taking the cuttings it is a good plan to give the old stools or clumps a thorough watering. This will have the effect of making all growths turgid and fresh, and, when in this condition, they will subsequently retain their condition better while rooting.

The most suitable cuttings are those about 3 in. or 4 in. long and these should be cut straight across at the bottom or lower end with a sharp knife (or razor blade) immediately below a leaf node or joint. They can be raised by inserting them about a third of their length in shallow boxes or pots filled with a light, sandy-soil compost. When raising the cuttings in boxes, they should be spaced about 4 in. apart each way; when pots are used they should be spaced evenly around the margin. The soil should be well firmed around the base of the cuttings during the planting and, afterwards, they should be thoroughly watered with a fine-rosed watering can. The cuttings will root quite easily without any artificial aid, but quicker rooting and bigger root systems can be secured by dipping them in a hormone rooting powder before planting.

The cuttings should be kept in shaded positions which are sheltered from wind until rooting has taken place when they should be moved gradually into full sunshine. The cuttings must never be allowed to become dry; on the other hand overwatering must be avoided.

Most single chrysanthemums in this State are grown in beds or borders—sometimes in masses and often in clumps situated here and there among other flowers. Used either way, they are most attractive in the garden. Those who grow the singles for cut-flower purposes only usually confine them to beds in the back garden where the removal of blooms will not detract from the appearance of the home surroundings.

The large and medium-sized decoratives, as well as the Japanese incurves, can also be grown in beds in the garden, but to obtain the finest flowers from these types, they are best grown in pots where their requirements can be more readily supplied.

Fig. 3.—Prepared cutting, ready for insertion. Note the removal of the lower leaves and that the cut is just below a node.

PREPARING BEDS

Ground in which single or other kinds of chrysanthemums are to be grown should be dug over a month beforehand. During the digging over, a generous layer of animal manure or vegetable compost, plus a dressing of potato manure (E), used at the rate of a handful to the square yard, should be well mixed through the top spit of soil. Double digging is unnecessary, since the plants obtain all their requirements from the top 9 in. of soil.

When transplanting the rooted cuttings, lift them out of the boxes or pots with as little disturbance of the roots as possible and plant them just a trifle deeper than before. It is important that young chrysanthemums should be firmly planted and they should be thoroughly watered immediately after planting to eliminate any air pockets which may have formed around the roots.

Whether grown in clumps or large groups, chrysanthemums should be spaced about 18 in. apart and stakes to support them should be placed in position at planting time.

POTTING

Chrysanthemums which are to be grown in pots should first be potted into 5 in. pots. When these are well filled with roots, the plants should be moved into 9 or 10 in. pots or even larger tins. At one time it was considered essential that chrysanthemums should be potted three times, first into 4 in. pots, then into 6 in. pots, and finally into 9 or 10 in. pots, but experiments conducted at the John Innes Research Station showed that so much potting was quite unnecessary.

For the first potting a compost composed of two parts of loam, one part of old animal manure and a half-part of sand should be prepared and to every barrow-load of this mixture should be added a 5 in. potful of potato manure (E).

For the final potting the compost should be composed of three parts loam, one part old animal manure, one part compost, half-part sand and half-part of wood ashes. To every barrow load of this mixture should be added a 4 in. potful of potato manure (E) and a 4 in. potful of blood and bone.

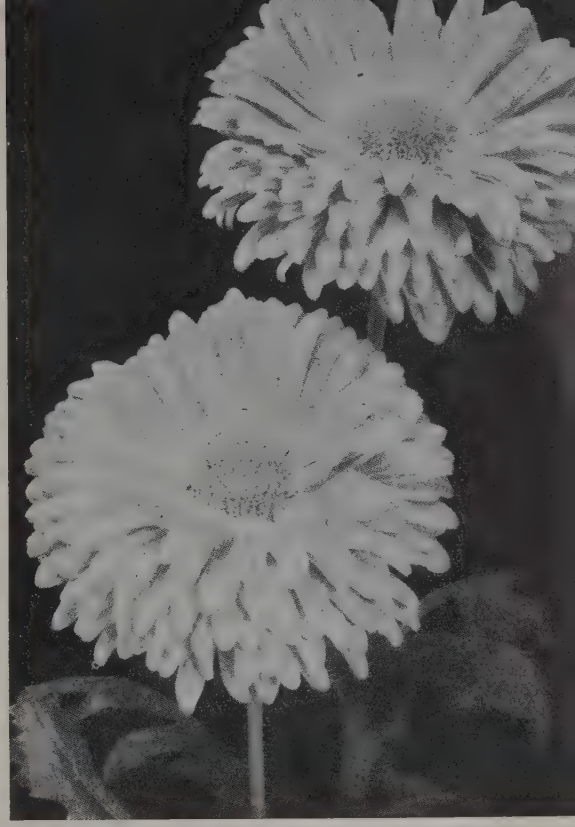

Fig. 4.—A good type of semi-single Chrysanthemum very suitable for garden decoration.

Plenty of crocks must be placed in the bottom of the pots to provide adequate drainage and firm potting is essential.

Plants in pots must also be fed during the growing period, because no compost, however rich it may be at the outset, will see the plants through to maturity. It must also be remembered that every time water is given a certain amount of food is washed out of the pots and this must be replaced.

Feeding should commence a few weeks after the plants are moved into the larger pots and be continued until the flower buds are well developed and showing colour. Liquid fowl and liquid cow manure are both excellent plant foods and could be used on alternate weeks. On the other weeks the pots could be dressed with a sprinkle of blood and bone and sulphate of potash.

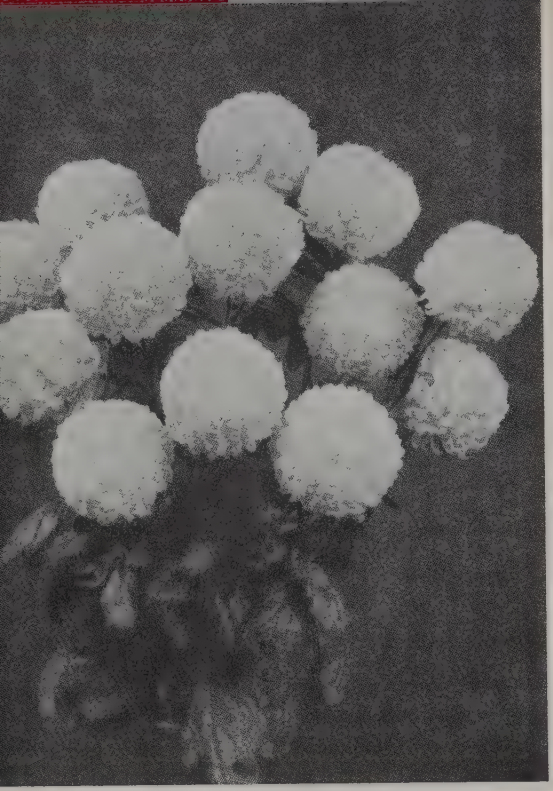

Fig. 5.—A vase of the popular incurved blooms.

"STOPPING"

Many chrysanthemums do not branch satisfactorily or early enough unless they are "stopped." Instead of branching, the central stem grows up and up until it is tall and lanky. Stopping is merely the cutting or pinching out of the growing tip, or a little more, of the plant.

With the singles and small semi-doubles grown in the garden, one stopping is usually sufficient to cause sufficient breaks (or branches) and this may be done between the middle and end of January. There is no reason why it should not be done later if desired, but late stopping merely means later flowers.

With most of the larger decoratives and Japanese incurves grown in pots, the best flowers are those produced by what are known as second crown buds. To obtain these the plants must be stopped twice. The time of the first stopping is not important. Remove the tip of the main stem as soon as the plants are forward enough to give three good breaks (branches) and allow only three branches to grow.

The second stop should be made about the end of January or early in February by removing the tip of each of the three breaks. Allow only two shoots to grow on each, thus giving six stems per plant. Six stems per plant should provide six splendid flowers.

If more flowers per plant are required, then more breaks must be allowed, but the flowers will be smaller.

Chrysanthemums are really very hardy and require no coddling. Keep them well tied to stakes, feed and water them when necessary, and I am sure you will be well satisfied with the results. Should the plants be worried by grubs, worms, or aphis at any time give them an occasional dusting with a dust containing DDT and BHC and you will have no further worries.

"FARM AND HOME"

WE regret the omission of the popular "Farm and Home" section from this issue—particularly as the omission is due to the illness of Miss H. M. Gloster, who has conducted the feature since its inception. We know that readers will join with the editorial staff in wishing Miss Gloster a speedy recovery.

Miss B. Cleeve, who deputised for Miss Gloster in the March-April issue, has prepared an article on cake-icing for the July-August number.

WHEAT VARIETY TRIALS ON RESEARCH STATIONS, 1953

By F. L. SHIER, Superintendent of Wheat Farming,
and J. REEVES, Agricultural Adviser.

EACH season, wheat variety trials are carried out at the research stations to compare the yielding ability of new varieties produced in this and other Australian States with standard varieties under commercial cultivation. Locally-produced crossbreds included in these trials have been developed to meet the demand for high-yielding varieties suited to local conditions. Particular attention has been paid to better straw strength, disease resistance and to improved baking quality.

The rainfall figures for 1953 for each of the research stations are summarised in Table 1.

TABLE 1.

Rainfall at Research Stations, 1953/54 Season.

Station.	Mar.	Apr.	Growing Period Rainfall.							Annual Total.
			May.	June.	July.	Aug.	Sept.	Oct.	Total.	
Avondale, 1953	48	150	410	429	236	98	59	150	1,382	1,646
Average, 27 years	85	85	216	329	296	219	102	80	1,244	1,567
Chapman, 1953	203	110	414	472	276	113	92	143	1,510	1,890
Average, 48 years	64	77	233	415	387	256	142	88	1,522	1,789
Esperance, 1953	155	110	277	264	125	224	148	109	1,147	1,732
Average, 4 years	60	130	329	246	234	238	314	180	1,543	2,066
Merredin, 1953	374	158	279	222	185	129	46	59	920	1,523
Average, 43 years	91	86	137	187	182	148	78	73	806	1,175
Salmon Gums, 1953....	231	129	103	221	135	141	88	76	764	1,360
Average, 28 years	128	88	129	152	143	142	102	114	782	1,340
Wongan Hills, 1953....	234	204	386	336	224	109	30	72	1,157	1,680
Average, 28 years	91	96	188	261	260	195	90	70	1,064	1,406

All stations received heavy soaking rains in March and April, enabling an early start to be made with cultural operations preparatory to seeding.

At Avondale and Merredin, heavy rains were recorded in May followed by almost continuous falls in June, and the consequent waterlogged conditions delayed seeding. However, from the middle of July onwards, fine, mild weather and below average rainfall dried out the ground enabling crops to recover from their earlier water-logging. Under more normal conditions the seeding was completed on time at the other stations.

Timely rains in September and early October provided a good finish to the season, resulting generally in above average yields at all stations except at Merredin where yields were slightly below normal.

DISEASE RESISTANCE

Flag Smut.—With the exception of Gabo and possibly Insignia 49, all varieties under trial are resistant to this disease. Aspects of flag smut control and the relative efficiency of several fungicides are discussed elsewhere in this Journal.

Stem Rust.—Light infections of this disease developed in a number of districts and from these infections race identification studies showed no apparent change in the races present in this State. The complex of rust races originating in the Eastern States in 1948 and since named races 222AB and 222BB have not been recorded here. Varieties such as Bencubbin 48, Javelin 48, Insignia 49, Gabo and Sabre, which are susceptible to these two races can, therefore, still be regarded as resistant to rust in W.A. Dowerin, Festival, Panther and the crossbreds M.107 to M.115 (inclusive) are resistant to all races of stem rust known to occur in Australia. Eureka and Wongoondy are susceptible to race 126B which has been recorded in this State but so far has not been observed in epidemic form on either variety.

FLOUR STRENGTH

Wheat breeders endeavour to combine in the one variety the two desirable characters, high yield and superior flour quality. However, their efforts can be nullified if a short, fertility destroying rotation is practiced on the farm. A suitable long term rotation, particularly if it includes a period under a legume, such as subterranean clover or lupins has a very pronounced influence on both the quantity and quality of protein and the subsequent baking quality of the flour.

The influence of the type of rotation on yield, quantity of gluten (protein) and the baking strength of the flour is illustrated by the rotation experiment at Wongan Hills.

Average Figures for the Four Years, 1944-47.

	Yield. bus/ac.	Gluten Content. %	Strength Figure. Minutes.
Continuous Wheat	4·7	6·9	5·3
Fallow, wheat	14·3	7·4	6·1
Pasture, fallow, wheat	18·3	7·5	6·8
Two years legumes, fallow wheat	*19·3	8·2	8·8

* Affected by " take all " in 1944 and 1947.

DISCUSSION OF RESULTS

The more important characteristics of the varieties under trial are tabulated in Table 2, while their yielding ability is summarised in Table 3. As in previous years, Bencubbin was used as the control variety in the early planted trials which

Fig. 1.—A new wheat variety being developed by cross breeding at the Merredin Research Station.

TABLE 2.

Characteristics of Varieties Under Trial.

Variety.	Produced by.	Maturity.	Stem Rust Resistance.	Flag Smut Resistance.	Grain Quality.
Bungulla	W.A. Dept. of Agriculture	Very early	Susceptible	Resistant	F.A.Q.
Bencubbin	do. do.	Midseason	do.	do.	do.
Kondut	do. do.	Late midseason	do.	do.	Medium strong
Wongoondy	do. do.	Early	do.*	do.	Nearly strong
Dowerin	do. do.	Early midseason	Resistant	do.	Above F.A.Q.
Eureka	N.S.W. Dept. of Agriculture	Midseason	Susceptible*	Highly resist.	Nearly strong
Festival	do. do.	Early midseason	Resistant	do. do.	Strong
Gabo	Sydney University	Early	do.	Susceptible	Nearly strong
Insignia 49	Waite Institute	Early	do.	Moderately sus.	F.A.Q.
Javelin 48	do. do.	Midseason	do.	Resistant	Medium strong
Bencubbin 48....	do. do.	do.	do.	do.	F.A.Q.
Panther	do. do.	Late midseason	do.	do.	Medium strong
Sabre	Roseworthy College	Midseason	do.	do.	Medium strong
M. 107	W.A. Dept. of Agriculture	Early midseason	do.	do.	Above F.A.Q.
M. 109	do. do.	do. do.	do.	do.	Medium strong
M. 112	do. do.	Midseason	do.	do.	Strong
M. 114	do. do.	Early midseason	do.	Highly resist.	Medium strong
M. 115	do. do.	Early	do.	do. do.	Nearly strong

* See Text.

included late mid-season and mid-season maturing varieties. For the late planted trials with early maturing varieties, Bungulla was the control.

VARIETIES FOR EARLY PLANTING

As in previous trials the yields of Bencubbin 48 were somewhat disappointing. Bencubbin outyielded it at Avondale, Merredin and Salmon Gums, while at the other three stations the yields of these two varieties were the same. Bencubbin 48 can only be recommended for planting in areas where stem rust is an appreciable hazard.

Javelin 48 outyielded all other varieties at both Avondale and Merredin, while on other stations its yield was equal to that of Bencubbin. In last year's trials Javelin 48 showed considerable promise as a mid-season variety for early planting.

Both Festival and Panther gave low yields and neither appears suited to local conditions, with the possible exception of the latter in the Esperance area where it has outyielded Bencubbin by 14% over a three year period.

Kondut and Eureka, as in previous years, have given satisfactory yields at both Avondale and Chapman, indicating their suitability for the higher rainfall areas.

A new variety Sabre, released by Roseworthy College, South Australia, was under trial for the first time. It was only tested on the Esperance Station and was outyielded by Eureka, Bencubbin and Javelin 48.

The early planted trial at Wongan Hills was badly affected by "take-all" and the yields for 1953 have not been included in Table 3.

VARIETIES FOR LATE PLANTING

Insignia 49 again yielded well; at Chapman and Salmon Gums it outyielded all other early maturing varieties, while at Avondale it was only outyielded by Gabo. Unfortunately the flour quality of Insignia 49 is lower than that of Gabo and Wongoondy, whilst preliminary tests indicate it is only moderately resistant to flag smut.

Last season Gabo yielded better than Wongoondy at most stations. However, considering the results for the previous eight years, it will be seen that the yields of these two varieties are approximately the same. At Avondale they both generally yield better than Bungulla while at Chapman and Merredin the yields of all three are about the same. At Salmon Gums

Wheat Variety Trials at Research Stations, 1953-54 Season.

	AVONDALE.			CHAPMAN			MERREDIN.			SALMON GUMS.			WONGAN HILLS.			ESPERANCE PLAINS.		
	Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.		Yield.	Percentage of Control.	
		1953	Average.		1953	Average		1953	Average		1953	Average		1953	Average		1953	Average
	Bus.	%	%	Bus.	%	%	Bus.	%	%	Bus.	%	%	Bus.	%	%	Bus.	%	%
Midseason Maturing Varieties																		
Bencubbin	23·4	100	100	32·7	100	100	23·6	100	100	18·6	100	100	..	..	100	15·6	100	100
Bencubbin 48	21·9	94	(3) 96	29·5	90	(3) 89	19·3	82	(3) 85	16·5	89	(3) 96	..	.	(2) 99	14·8	95	(3) 106
Javelin 48	28·8	123	(2) 110	31·3	96	(2) 95	25·7	109	(2) 104	18·6	100	(2) 94	..	....	(1) 84	15·5	99	(2) 97
Kondut	25·9	111	(10) 106	33·8	103	(10) 101	....	....	....	....	....	....	....	....	(8) 94	....	....	....
Eureka	26·8	115	(10) 110	33·8	103	(10) 101	....	....	....	17·7	95	(10) 90	..	....	(8) 96	16·2	104	(2) 98
Festival	25·1	108	....	30·5	93	....	18·1	77	....	16·1	87	....	....	....	....	11·9	76	....
Panther	18·8	80	(2) 90	31·2	96	(2) 95	....	....	....	16·0	86	(2) 81	....	....	(1) 81	14·9	95	(3) 114
Sabre	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	14·2	91	....
M. 112	24·3	104	....	27·6	85	....	21·1	89	....	17·0	91	....	....	....	....	13·7	88	....
Difference for Significance—P = ·05	1·3	6%	....	3·4	10%	..	1·7	7%	....	0·9	5%	.	..	....	....	0·9	6%	....
Early-midseason Maturing Varieties—																		
Bencubbin	....	....	....	34·9	100	100	14·0	100	100	17·0	100	....	33·5	100	100	....	....	....
Eureka	....	....	....	29·6	85	(2) 93	12·1	86	(2) 81	16·7	98	..	33·0	98	(2) 98	....	....	....
Dowerin	....	....	....	22·1	63	(2) 73	16·3	116	(2) 103	15·7	92	..	31·0	92	(2) 89	....	....	....
M. 107	....	....	....	32·8	94	(2) 99	14·9	106	(2) 93	15·6	92	..	32·5	97	(2) 99	....	.	....
M. 109	....	....	....	31·0	89	(2) 95	15·3	109	(2) 101	17·4	103	..	32·5	97	(2) 95	....	.	....
M. 114	....	....	....	....	....	....	15·8	113	....	....	....	....	34·5	103	....	....	..	....
Difference for Significance—P = ·05	..	.	..	1·8	5%		Not significant.			1·2	7%	..	1·7	5%	....	..	.	..
Early Maturing Varieties—																		
Bungulla	28·3	100	100	25·9	100	100	6·5	100	100	17·7	100	100	23·7	100	100	..	..	..
Gabo	31·6	112	(7) 113	27·9	107	(6) 100	7·1	109	(8) 96	19·6	111	(7) 100	28·0	118	(7) 101	..	..	..
Wongoondy	29·8	105	(8) 109	23·8	92	(7) 97	9·7	149	(8) 99	19·7	111	(8) 105	22·2	94	(8) 94	.	....	....
Insignia 49	30·1	107	(2) 103	33·0	127	(2) 121	8·7	134	(3) 108	22·3	126	(3) 118	27·7	117	(3) 105	...	....	....
M. 115	....	....	....	....	.		4·4	67	.	...	....	..	25·3	107	..	....	..	..
Difference for Significance—P = ·05	0·8	3%	....	2·4	9%	....	1·4	22%	....	1·3	7%	....	2·0	8%	....	....	....	....

N.B.—Figures in brackets indicate the number of years under trial.

Fig. 2.—A general view of the variety trials at the Wongan Hills Research Station. Each plot is one-tenth of an acre in area.

Wongoondy outyields Bungulla and Gabo but at Wongan Hills the position is reversed. Both Gabo and Wongoondy can be recommended for late planting in all wheat growing areas. Further, because of their good straw strength they are well suited for growing on the "lighter" soils, including the higher rainfall clover-ley areas.

CROSS-BRED VARIETIES

Five un-named crossbred varieties, developed on the Merredin Research Station, were under test for yield. M.107 and M.109 are selections from a cross between Kenya C.6041 and Eureka 11; M.112 is a Eureka 11 x M.61 cross and M.114 and M.115 are both from Eureka 11 x M.60 (M.60 and M.61 are from the same cross, Sword x

TABLE 4.

Recommended Varieties.

Maturity Group.	Zone 1 (Early).	Zone 2 (Midseason).	Zone 3 (Late).
	Less than 14in. Annual Rainfall.	14in. to 18in. Annual Rainfall.	Above 18in. Annual Rainfall.
Midseason and Late Midseason	Bencubbin	Kondut Eureka Bencubbin Bencubbin 48 *	Kondut Eureka Bencubbin Bencubbin 48 *
Early and Very Early	Bungulla Wongoondy Gabo	Gabo Wongoondy Bungulla	Gabo Wongoondy Bungulla

* Bencubbin 48 is recommended in preference to Bencubbin in districts with a high rust hazard.

Kenya C.6041). The Eureka parent was used for its straw strength, flour quality and flag smut resistance and Kenya C.6041 for rust resistance. M.112 has generally given below average yields and has been discarded.

In the early mid-season trial both M.107 and M.109 appear to be at least equal to Bencubbin in yield, whilst from the limited data available M.114 appears better than the other three. Further trials are necessary before their relative yielding ability can be accurately assessed. This also applies to M.115 which was only tested in the late planted trials at Wongan Hills and Merredin.

As a guide to planting, the recommended varieties, for each of the three major zones of the wheatbelt, are listed in order of preference in Table 4. Neither Javelin 48 nor Insignia 49 have been included in this list as they have not yet been tested for a sufficient number of years for their yielding ability to be accurately determined.

DAIRY CATTLE IMPROVEMENT ACT

Bull Registration

THE Minister for Agriculture (Mr. E. K. Hoar) has drawn attention to the requirements of the Dairy Cattle Improvement Act relative to the registration of bulls.

The Act provides that all bulls in the South-West division of the State must be registered, with the exception of pedigree beef strain animals kept solely for beef production, which may be exempted on application to the Director of Agriculture.

Certified pure-bred bulls are registered on payment of a fee of 10s. for life, but grade bulls must be registered annually and a fee of 5s. paid with each application.

Registration of grade bulls was due on the 1st of January (1954), and the Act stipulates that owners who have not complied with the regulations are liable to a penalty of not less than £20.

The Department should be notified immediately of the death or transfer of any registered bull.

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TOBACCO SEEDLING PRODUCTION

By T. G. HANEY, Officer-in-Charge, Tobacco Branch.

Production of a high quality crop of tobacco begins in the seedbed, and it is therefore essential that the utmost care and attention be given to this stage of the crop. In general, it has been found that it is better to grow one's own seedlings, rather than rely on those from an outside source, thus ensuring that strong, healthy seedlings of the correct variety and strain are available at the time of transplanting.

The first factor to be considered is the selection of the site of the seedbed. It has been recommended that twice the area required be fenced off, preferably with rabbit netting, so that the area on which the seedlings are grown each year can be alternated. In this way, build-up of weeds and diseases is prevented, as the portion not being used can be cultivated and kept free of weeds and host plants for diseases and insects. A shelter belt of shrubs could also be planted around the area for wind protection. The soil type selected should be a deep, well-drained, sandy loam, which does not form a surface crust. If an ideal soil type cannot be found in a convenient position, leaf-mould soil from the bush can be carted and built up in the beds to a depth of at least six inches.

Efficient drainage of the soil tends to make it warmer, and in some cases, it has been found advantageous to build up the seedbeds to a foot above ground level. Experiments have shown that low temperatures while plants are in the seedbed is one of the causes of premature blossoming in a tobacco crop, and any treatment which tends to give a higher soil temperature will be advantageous to the ensuing crop.

Sunlight is essential for warming of the soil and rapid growth of seedlings, so the site selected should have preferably a northerly slope in order to gain the maximum amount of sunlight throughout the day, and prevent excessive shade cast from the framework, from covering the beds.

The final consideration in choosing the seed-bed site is proximity to water supply. Beds, especially during the germination period, require ample moisture, and a plentiful supply of water is necessary. This water should be tested for quantity of salts in solution, and if too high, an alternative supply must be found.

The usual size of the plant bed is 18 feet long by 3 feet wide. In building up the beds for efficient drainage, six inches overlap should be allowed all round so the framework can be placed on top of the soil and there is no breaking away of the edges.

WEED AND DISEASE CONTROL

Several substances have recently been tested which give a certain amount of control of weeds and diseases in seedbeds and preliminary trials have been made in the district. One of these, C.B.P. 55, when injected into the soil controlled the growth

A set of built-up, well-drained, seed beds at the Tobacco Research Station, Manjimup.

of weeds such as sorrel and nightshade, but had little effect on germination of grass seeds. No diseases were apparent in these treated beds. Further tests will be made using the emulsified concentrate which can be applied as a drench to the soil. Since there appears to be a build up of nematodes in the district, it is advisable to treat beds with a nematicide, so that seedlings are free of this disorder when transplanted. Further details of the application of these substances will be given after another series of experiments have been conducted.

FERTILISING

Recent trials have indicated that the application of up to 4 lb. per square yard of tobacco fertiliser to the plant bed give an increased number of healthier seedlings at an earlier date than when the previously recommended rate of 1 lb. per square yard was used. The applied fertiliser should be well mixed with the surface four inches of soil and the bed should then be levelled off, so that when watering is carried out, it does not tend to wash the top surface or lay in pools. After levelling, it is best to tamp the surface to create a firm foundation for the seeds.

FRAME CONSTRUCTION

After fertilising and levelling, the bed is now ready to have the framework put into position. Frames should be 6 in. high in the front and 12 in. high at the back, fitted with calico or canvas roller tops. Previously, a hinged top was suggested but it has been found by experience that these do not give a satisfactory seal for benzol vapours. The initial cost of canvas is higher than calico, but it is longer lasting, and more water and gas proof. Whatever material is used, it should be treated with a mildew-proofing agent such as "Shirlan W.S." by soaking it in a solution of one pound of the substance to 10 gallons of water, and then hung out to dry. Precaution should be taken against shrinkage if the material is to be cut before treatment. The use of windowlite is not recommended during early stages of seedling growth, since it tends to dry out the surface soil excessively. However, when the plants are bigger, it may be used with advantage provided sufficient water is applied and enough time given for the plants to harden off before transplanting.

SOWING THE SEED

One ounce of tobacco seed contains approximately 300,000 seeds, and theoretically is enough to plant 50 acres. However, allowance has to be made for percentage germination and selection of seedlings, and it is recommended that for every plant required, ten seeds should be sown. Thus, one ounce of seed should be sufficient for planting five acres of crop. There are approximately 12 level teaspoonfuls of seed to the ounce, and the best rate of sowing is one teaspoonful for each 100 square feet of seed-bed area. Since the seed is so fine, it is generally mixed with fine sand or sifted ashes for even spreading. An alternative method is to stir the seed into a watering can with holes large enough in the rose to allow seed to go through, and then water the beds with the seed in suspension. The sowing of pre-germinated seed is not recommended, as there is a danger of damaging the emerging root when sowing is carried out.

One of the most common causes of poor germination in seed beds is insufficient watering. Once germination commences, the seed should not be allowed to dry out, even for a few hours. In order to keep the surface soil, in which the seed is contained, moist at all times, it is advisable to spread a mulch after the seed is sown. Generally, a thin covering of coarse sand is used, care being taken, however, that it is not too thick. Coarse sand is used to prevent wash when watering. Pine sawdust has been used successfully, but it has a tendency to blow to the edges of the bed during windy weather.

Time of sowing of the seed has an effect both on the time taken for germination and the period when the seedlings will be ready for transplanting. Seed sown towards the end of July generally takes from three to six weeks to germinate, and seedlings should be ready for transplanting by mid-October, depending on weather conditions. Once warmer weather sets in, however, seed germinates in a period of one to three weeks. For mid-November plantings seed should be sown at the end of August.

After the seed has been sown and a mulch provided, seedbeds are then covered in order to prevent washing by heavy rain and also to endeavour to warm up the soil. The use of windowlite covers is not recommended at this stage, since there is a ten-

dency for the surface soil to dry out when this material is used. It is advisable to roll the covers back for an hour or so each day, to prevent a build-up of excessive humidity within the frame, thus creating conditions favourable for the developing of diseases and the formation of green moss on the surface. In warm dry weather, the beds may have to be watered several times during the day in order to keep them moist. Too much stress cannot be laid on this aspect.

WATERING

After the plants have become established, the method of watering should be altered, so that beds, instead of receiving light waterings several times per day, receive heavier waterings at less frequent intervals. Apart from encouraging better root development, this tends to leach to lower levels any fertiliser or other salts which may have been brought to the surface during the frequent, light watering period. An excess of salts in the surface layers can cause injury to the developing seedlings. During this period, the plants should not be allowed to wilt.

From about two weeks before the time of transplanting the hardening off process should commence, to allow seedlings to develop a hardiness for conditions which ensue after they are set in the field. The number of waterings is gradually decreased from this time so that plants develop a certain degree of drought resistance. For a week before transplanting, the seedlings should be able to do without water without excessive wilting.

If the seedlings are retarded in development, they can be forced by covering the beds with windowlite during the warmer periods of the day, but this practice should not be carried out during the hardening-off process. Another method used to force seedlings, where there appears to be a fertiliser deficiency, is to water the beds weekly with a solution of nitrate of soda. Two ounces of this substance are mixed with four gallons of water and spread over the beds. It is advisable to water the beds after this treatment to wash off any excess on the leaves.

TRANSPLANTING

Seedlings are ready for transplanting when they reach a height of from four to six inches. Planting seedlings which are too big causes them to be burnt on the stem and necessitates replanting. If it can be seen that some plants are becoming too large before the land is in a suitable condition, it is advisable to pull these, thus allowing other smaller plants to obtain a suitable size and condition.

Before pulling plants, the beds should be given a thorough soaking to allow some soil to adhere to the roots when they are taken from the bed. After the beds have been pulled, they should again be watered to settle in the remaining seedlings.

INSECT PESTS

The most common insect pests which cause damage to tobacco seedlings are slugs, cutworms, seed harvesting ants, red legged earth mite and clover beetles.

A solution of 0.02% D.D.T. sprayed on to and surrounding the beds is the most effective mode of control for general pests. It is wise to use this spray at weekly intervals, and care must be taken that the strength of the solution is not too strong, otherwise injury and distortion of the developing seedlings may occur. If seed harvesting ants appear in the beds, a sprinkling of 20% D.D.T. dust around the holes should prevent further damage.

Where seedbeds have been planted near pasture, it is possible that clover beetles may cause damage to the young seedlings. In this case, a bait consisting of 40lb. bran, 1lb. Paris green and 3lb. molasses, mixed with enough water to make a crumbling mash should be scattered in the evening around the outside of the wooden frames.

DISEASES

The two major seedbed diseases encountered are damping-off and blue mould.

Damping-off is a disease of seedlings caused by numerous fungi or moulds. The development of these moulds is favoured by excessively moist conditions, which is the reason why it is advisable to give the beds sufficient aeration and sunlight during the germination period.

Pre-emergence damping-off occurs after germination of the seed and before the small seedlings appear on the surface. Failure to germinate is sometimes the result of an attack of damping-off. For this reason, it is advisable to treat seed

with a fungicidal dust before it is sown. All seed purchased from the Department is treated with a fermate dust.

A further method of control for pre-emergence damping-off is to water the beds at weekly intervals with a solution containing copper, as soon as the beds are sown. There are several proprietary products on the market which give good control of the disease. "Chestnut Mixture" is generally used but this mixture has to be made up freshly each time before use. After germination, this weekly treatment should continue to control post-emergence damping-off.

The usual symptoms of post-emergence damping-off are the appearance of a watersoaked area at ground level, after which the plants fall over. Once the disease starts on one plant it spreads in everwidening circles until a mass of rotting plants results. As mentioned previously, watering with copper mixtures will give control.

Blue Mould.

This fungus disease can attack plants at any stage, but in this area, it generally makes its appearance about three weeks after germination. The first symptom of the disease is the appearance of yellow blotches on the upper surface of the leaves. If not checked, a mould-like violet fungus growth appears on the undersurface of leaves within several days. Spores, or seeds of the fungus, then rapidly spread to all parts of the seedbed area.

Benzol will give complete control of this disease when properly used. When the substance is placed in the beds and allowed to evaporate, the fumes produced kill mould spores and also any fungal mycelin within the leaf tissue. This coal-tar derivative is highly inflammable and should not be handled near an open flame.

The use of benzol commences approximately three weeks after germination of the seed. At this stage, however, it is used at half the normal concentration. With relatively low night temperatures experienced in this district, it is recommended that the ratio of 1 : 100 of evaporating surface to seedbed area be used. Flat tins, not more than one inch deep should be used, and for ease of handling, a tin of four inch diameter is recommended. To give an example, if the seedbed is 18ft. x 3ft., the total area is 7,776 square inches. A tin with a diameter of four inches has a surface area of 12½ square inches. Therefore, to obtain the ratio of 1 : 100, the evaporating surface required is 77.76 square inches, and six tins of this size will give the approximate area required. These tins should be placed at regular intervals along the length of the seedbed. Care must be taken when filling these tins to ensure that no benzol splashes on to the seedlings, as it is fatal to seedlings. There are several types of fillers which can be readily made up. The tins are filled every evening and the calico covers are then pulled over the beds and arranged so that the beds are as airtight as possible to prevent escape of the benzol vapour. If higher than normal night temperatures occur, the number of tins may have to be reduced. It is desirable that only sufficient benzol is placed in the tins so that little remains by morning and it can be discarded. During evaporation, the more volatile fractions of the liquid vaporise first, and if the remaining liquid is continually poured back into the drum, the proportion of these fractions increases, and towards the end of the drum, the desired amount of evaporation does not take place.

Treatment of the beds should continue until plants are no longer required. If, for some reason, an outbreak of blue mould does occur, continuous day and night treatment should be carried out for at least four days.

SUMMARY

1. Select your seed-bed site at a place convenient to good water and to ensure maximum sunlight.
2. Allow ample drainage by building up the beds.
3. Fertilise sufficiently and correctly.
4. Sow seed at correct rate—seeding too heavily produces weak plants.
5. Water judiciously during germination and later stages.
6. Applying fungicide for control of damping-off.
7. Make use of the correct insecticides at recommended rates.
8. Ensure that beds are airtight for use of benzol for blue mould control.

FERTILISER APPLICATION FOR TOBACCO SEED BEDS

By A. J. E. LYNEHAM, B.Sc. (Agric.), Tobacco Adviser.

An important phase of tobacco production is the growing of healthy seedlings in as short a time as possible. Recent experiments overseas have shown that the older the seedlings at the transplanting time, and the lower the temperatures have been during the seed bed stage, the sooner the plants bloom once they are set in the field.

In 1953, a trial was conducted to determine the optimum rate of fertiliser application. The following treatments were applied:—

1. No fertiliser.
2. ½ lb. per square yard.
3. 1 lb. per square yard.
4. 2 lb. per square yard.
5. 4 lb. per square yard.

Design.

The trial was conducted in seed beds, 9 ft. long and 3 ft. wide, divided into plots and buffers as shown below:—

Each plot of 2/3 sq. yard was replicated four times.

Procedure.

Virgin bush soil was brought in and built up to approximately 18 in. above ground level, in order to allow free drainage and to endeavour to raise the soil temperature. Wooden frames were then placed on top of the built up soil. The plots were fertilised on 19/7/53 and seed was sown on 28/7/53. After sowing, beds were covered with a mulch of pine sawdust and kept watered.

Germination occurred approximately six weeks after sowing, the soil temperature at time of sowing being 44 deg. F. at a depth of 4 in. By the 21/9/53, it was possible to see the effects of the no fertiliser treatment. No growth occurred at all after germination.

Seedlings were pulled as they reached the transplanting stage at 4-6 in., and numbers of seedlings pulled each week are given in Table 1.

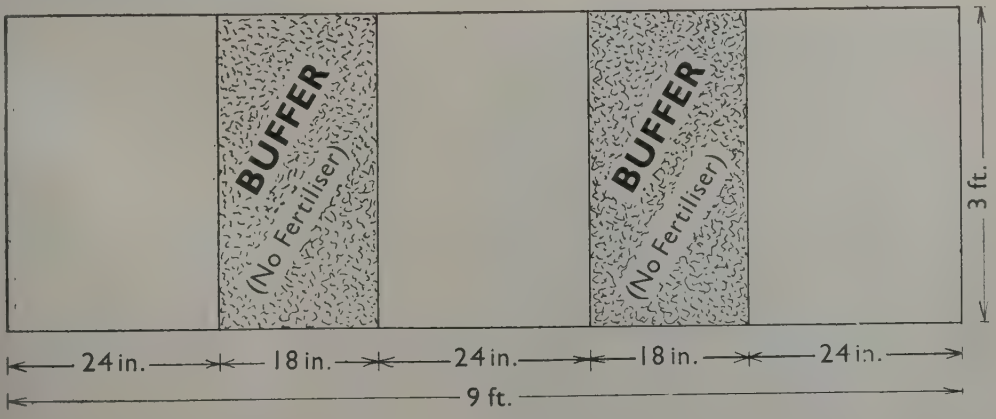


Table 1.

Replications.	Treatments.	Dates. 28/10.	5/11.	16/11.	17/11.	Total.
	A1	....	....	....	....	*Nil*
	2	....	....	....	80	80
	3	50	....	100	75	225
	4	....	150	175	....	325
	5	....	400	180	40	620
	B1	....	....	....	....	*Nil*
	2	....	....	25	....	25
	3	....	125	75	....	200
	4	200	....	40	50	290
	5	100	100	50	75	325
	C1	....	....	....	....	*Nil*
	2	....	....	90	25	115
	3	....	125	15	20	160
	4	....	75	115	30	220
	5	40	100	120	40	300
	D1	....	....	....	....	*Nil*
	2	....	....	50	25	75
	3	50	150	50	40	290
	4	125	100	50	75	350
	5	125	150	110	100	485

Table 2 gives the total numbers of seedlings pulled from each replication of each treatment.

Table 2.

Treatment.	Replication. A.	B.	C.	D.	Mean.
1	....	....	....	....	*Nil*
2	80	25	115	75	74
3	225	200	160	290	219
4	325	290	220	350	296
5	620	325	300	485	432

DISCUSSION.

Figures in Table 1 show that higher rates of fertiliser application produce plants which are a suitable size for transplanting several weeks earlier. Table 2 shows that the number of suitable plants is greatly increased, and plants themselves were stronger and healthier. It seems that the application of up to 4 lb. per square yard of 3.8 : 15 : 6 N.P.K. tobacco fertiliser would allow seed beds to be sown later in the season. The soil type used was a typical, light loamy sand which did not pack tight or create a hard surface with watering. Since it is a recommended practice to alternate the seed bed sites, the residual effect of this heavy application should have no detrimental effect on the succeeding crop.

SUMMARY.

On a loamy-sand virgin bush soil the application of 4 lb. per square yard of tobacco fertiliser produced an increased number of healthier seedlings at an earlier date than when the previously recommended rate of 1 lb. per square yard was used.

FREE SERVICE TO FARMERS

Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 258 and 259 of this issue.

These officers are there to help you and will make personal visits to your property to assist with on-the-spot advice. In addition, they will, where necessary, arrange for the services of specialist officers— all without cost to you.

PREGNANCY TOXAEMIA OF EWES

By C. R. TOOP, B.V.Sc., Chief Veterinary Surgeon.

WITH the approach of the lambing season, losses from pregnancy toxaemia are frequently sustained by sheep breeders. This disease has a world-wide distribution and has been described under a wide variety of names, the most common of these probably being "twin lamb disease," "pregnancy disease of ewes," and "pregnancy paralysis." It would perhaps be more appropriate to describe the disease as ketosis of pregnancy since there constantly occurs in the blood of affected animals an accumulation of toxic substances known as ketone bodies.

Pregnancy toxaemia affects ewes which are heavy in lamb. The losses are almost wholly confined to the last three or four weeks of pregnancy and few animals recover after the symptoms have become well established. Ewes carrying twin lambs or triplets are most frequently affected, hence the popular name "twin lamb disease" but ewes with single lambs may also develop the disease.

The outstanding feature at post-mortem is the extremely fatty appearance and pale yellow colour of the liver. The exact cause of the disease has not yet been determined but there is abundant evidence to show that it is nutritional in origin and that it is associated with under-feeding and loss of condition during late pregnancy.

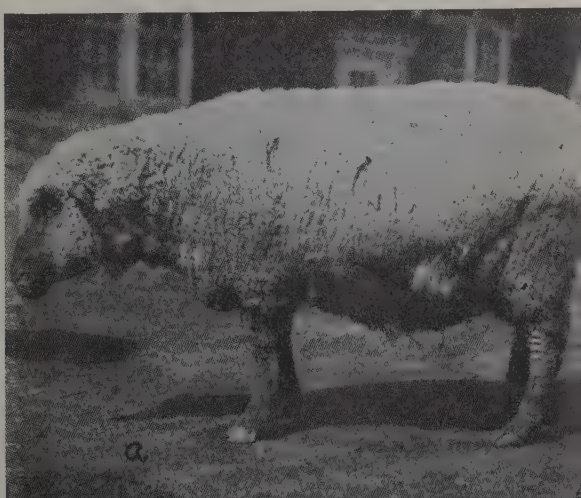
In Western Australia pregnancy toxaemia occurs throughout the agricultural areas but it has not been reported from the pastoral districts. The annual losses are extremely variable, and during some seasons mortalities may be numerous and widely distributed. In others, for reasons not well understood, they may be of comparatively rare occurrence. Similarly, losses in individual flocks are subject to considerable fluctuation. In some cases they may be small and insignificant but in others they may reach serious proportions, and in isolated instances have been known to approach the high figure of 50 per cent.

THE SYMPTOMS

Ewes of all ages and breeds are susceptible to the disease but due to the greater tendency towards twinning and multiple pregnancies, mature ewes are most frequently affected. The losses are almost entirely confined to the last three or four weeks of pregnancy but the disease may appear as early as six weeks before the due date of lambing. The affected ewe becomes dull, ceases to feed and separates itself from the flock. It appears dazed and stupid and pays little heed when approached. It is often possible to approach within a few feet of the animal or even touch it before it will attempt to move away. When so disturbed the animal moves off slowly and aimlessly, proceeding for a short distance only before

Fig. 1.—A ewe suffering from severe pregnancy toxaemia. Soon after this photograph was taken the animal became unable to stand and lapsed into a comatose condition.

(Photograph University of Illinois, Agricultural Experiment Station.)



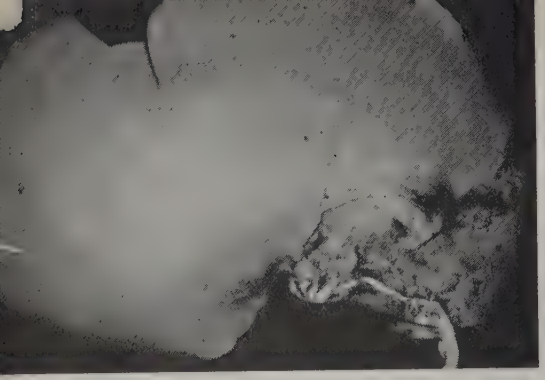


Fig. 2.—A liver from a sheep suffering from advanced pregnancy toxaemia. The photograph shows the light colour of the liver due to heavy infiltration with fat.
(Photograph University of Illinois, Agricultural Experiment Station.)

coming to a halt. In many affected animals there is complete blindness, while in others vision is seriously impaired. Grinding of the teeth and the presence of a thick mucus discharge from the nostrils are almost constant symptoms.

When driven, affected ewes frequently show a stiff, unsteady gait and may collapse after proceeding for a short distance, falling to the ground sometimes with the hind limbs extended behind the body. From this position the animal is usually unable to regain its feet without assistance. Later the ewe goes down and is unable to rise, lying in a comatose condition until death occurs. Affected animals may linger from a few days to a week or more from the first appearance of the symptoms. Few affected animals recover and the mortality rate is in the vicinity of 90 per cent. Should lambing occur in the early stages, recovery is possible but when the symptoms have become well advanced lambing does not influence the course of the disease and recovery at this stage is unlikely. Ewes which have already lambed do not become affected.

During the course of some outbreaks of pregnancy toxaemia, certain of the ewes, while remaining apparently healthy themselves, may give birth to dead or weak lambs and this occurrence is considered by some observers to be a further manifestation of the disease.

THE POST-MORTEM APPEARANCES —FATTY LIVER

At post-mortem the principal and frequently the only abnormality will be found in the liver. This organ, as the result of a heavy infiltration with fat, will appear somewhat enlarged and characteristically pale yellow in colour. Sometimes similar though much less marked changes occur in the kidneys, which may in consequence appear paler in colour than normal. In a high percentage of the cases two or more lambs will be found in the uterus.

THE PRE-DISPOSING FACTORS —UNDER-FEEDING.

Until fairly recently, the opinion was held that pregnancy toxaemia was associated with overfatness and lack of exercise during late pregnancy but this view now finds little support and is neither borne out by the field nor the experimental evidence. Experimentally it has not been found possible to produce the disease by feeding pregnant ewes to overfatness, and at the same time confining them in pens in which they have been able to obtain little or no exercise. Moreover when fat ewes become affected in the field, it is often possible to find evidence of underfeeding, though this may have been suddenly imposed and of comparatively short duration. On the other hand the opinion that the disease is associated with underfeeding and loss of condition during late pregnancy is strongly supported by both field and experimental evidence. It has been re-produced experimentally by continued under-feeding or by subjecting ewes to a period of sudden starvation. Furthermore in such cases there is evidence of an accumulation of ketone bodies in the blood and urine of the same order as that which is found in the naturally occurring cases of the disease. Ketone bodies cannot be demonstrated in the blood of fat ewes which are receiving an adequate ration.

Under field conditions, outbreaks of pregnancy toxaemia may occur when forward-in-lamb ewes are trucked long distances by rail and are, as a consequence, completely deprived of food for long periods. Similar outbreaks resulting from a period of enforced starvation may also be associated with prolonged yarding.

When mortalities from the disease have been investigated in this State, it has generally been found that the feed available has not been adequate and the ewes have shown evidence of loss of condition and in some cases they have been in poor condition. One mortality can be recalled which involved the loss of nearly 50 per cent. of a flock of full-mouthed ewes. The animals were in extremely low condition, the paddocks were bare and hand-feeding had not been practised.

Under West Australian conditions, unless measures are taken to prevent it by hand-feeding, it is almost inevitable that ewes will suffer from under-nutrition during the latter half of pregnancy and that this will become progressively more acute as lambing approaches. In the majority of flocks, lambing will be timed to commence during May, being preceded by a prolonged, and for the most part, dry summer season. During this period extending from October to May, the available grazing steadily deteriorates, becoming reduced in quality and often in quantity. It is quite inadequate to maintain the condition of the flock and unless hand-feeding is practised on an adequate scale, loss of condition is certain to result. Pregnancy toxaemia commonly occurs under such conditions.

During certain seasons, widespread mortalities have occurred following upon the opening autumn or early winter rains, especially when such rains have fallen at a time when lambing is about to commence or when the earlier lambs have already been dropped. For several weeks following these rains a period of acute feed shortage usually exists. The available dry feed is spoiled and the sheep walk the paddocks eagerly seeking the short and scanty green shoots. Until the green feed becomes well grown, under-nutrition together with loss of condition is inevitable. It has been observed that mortalities occurring under these circumstances have ceased when green feed has become plentiful or when it has been possible to turn the flock on to an early sown green crop.

When the disease appears amongst ewes which are in good condition and are being adequately hand fed, the possibility cannot be overlooked that certain of the less aggressive animals do not succeed in obtaining their full share of the ration and may in reality be falling off in condition.

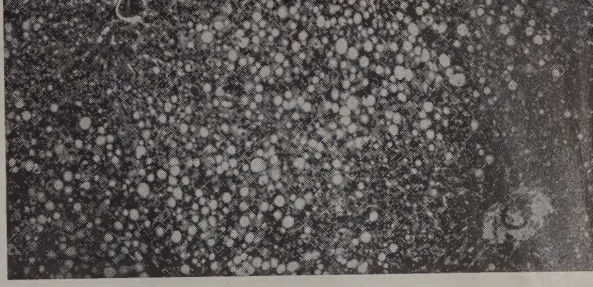


Fig. 3.—A section from the liver shown in Fig. 2 showing the fatty infiltration typical of the disease.
(Photograph University of Illinois, Agricultural Experiment Station.)

It thus becomes apparent that ewes whether in fat, poor or indifferent condition may become affected with pregnancy toxaemia if they are under-fed or are suddenly deprived of food during advanced pregnancy.

CAUSE

The exact cause of the disease has not been determined. In all affected ewes, however, the presence of toxic ketone bodies may be demonstrated in the blood and urine by chemical means. Moreover, the blood sugar falls to a level far below normal. It is suggested that the development of ketosis is associated with a low carbohydrate intake which occurs when the ration is inadequate. Carbohydrates are represented by such substances as starches and sugars, and are the main source from which the animal derives its energy requirements. In the animal body carbohydrate is stored in the liver in the form of glycogen. In the pregnant ewe this reserve store of glycogen is drawn upon to meet the increased requirements of the mother and of the rapidly developing lamb which stores glycogen in its own liver in quite large amounts. In a twin pregnancy the demands upon the glycogen reserves in the liver of the ewe are specially heavy, and they consequently become depleted and sink to a low level.

If in addition to this the carbohydrate intake is low as the result of under-feeding, the ewe is forced to draw upon its fat reserves in order to obtain its energy requirements. Fat is transported from the

fat deposits of the body to the liver where the first stage in its combustion or oxidation takes place. The liver in consequence, becomes heavily infiltrated with fat. When fat is completely burnt or oxidised in the body the end products are water and carbon dioxide, which are excreted and are harmless. When, however, there is a deficiency of carbohydrate, the oxidation of fat cannot proceed to completion. The process becomes arrested at an intermediate stage, wherein the fat has become converted into products known as ketone bodies which accumulate in the blood and make their appearance in the urine. Ketone bodies possess toxic properties and the symptoms observed in pregnancy toxaemia are attributable to their presence.

It must, however, be emphasised that the actual cause of the disease still remains rather obscure, and that certain of its features still require an explanation. Quite a number of theories have been advanced to account for its occurrence, but further research will be necessary before a clear understanding of the condition is finally obtained.

TREATMENT

No satisfactory method of treatment is known and after the symptoms have become well established, recovery rarely occurs. Good results have occasionally been claimed from the administration of sugar or molasses at the rate of 1 lb. to 1½ lb. daily, dissolved in water and given as a drench and from the intravenous injections of solutions of the sugar, glucose. The results of treatment however are generally so unsatisfactory that it must, in the majority of cases be regarded as hopeless.

PREVENTION

Supplementary Feeding.—The prevention of the disease appears to be largely a matter of feeding and management. Under-feeding, together with loss of condition, is the principal predisposing factor, and steps must be taken to prevent this occurring during late pregnancy. To ensure that ewes will at least maintain their condition during this period, hand-feeding will be necessary on the great majority of properties. The period at which hand-feeding should commence will depend upon the amount and quality of the grazing available in the paddocks and the condition of the sheep and will call for a good deal of discretion on the part of the individual sheep-owner. In general, however, hand-feeding should commence not later than eight weeks before the due date of lambing, with a tendency towards increasing the ration during the last month. The supplements available for hand-feeding will generally consist of wheat, oats, barley, chaff, hay and occasionally silage. Experiments carried out by the Animal Nutrition Officer of this Department have shown that, with very poor grazing available, pregnant ewes are more than able to maintain their condition on any of the following daily rations:—½ lb. wheat, ¼ lb. wheat plus 1½ lb. silage or ¼ lb. wheat plus ½ lb. chaff. From this information the recommendation may be made that hand-feeding be commenced in early or mid-summer with a daily allowance of ¼ lb. of wheat per head increasing to ½ lb. per head daily about six weeks before lambing is timed to commence. A daily addition of ½ lb. hay or chaff to the grain ration will be advisable if the grazing is scanty. Barley, which is similar in feeding value to wheat, should be fed in the same amounts.

The feeding value of oats is three-quarters that of wheat, and where oats are being fed, an adjustment will need to be made on the basis that 100 lb. of oats will replace 75 lb. of wheat in the ration. Chaff, hay or silage alone will not provide the full requirements of the animal.

Although no definite scale can be laid down, the above figures will serve as a guide to sheep-breeders, concerning the amounts of the different food supplements it will be necessary to make available. These rations should be sufficient to meet requirements during normal seasons but under drought conditions they would probably need to be somewhat increased during the last month of pregnancy in order that losses might be avoided. Quite apart from the aspect of disease prevention, however, feeding on this scale is desirable if the flock is to be carried through the summer and autumn months in satisfactory condition.

Green Crops.—The value of young nutritious green feed as a preventive has long been recognised, and when available it probably provides the most effective means of prevention and control. Early-sown green crops will be found of especial value in preventing those mortalities which may occur during the period of feed scarcity which follows the opening rains. Such crops will usually be well grown, and in a fit condition to allow of grazing quite a considerable time before the natural pasture is sufficiently advanced to fully satisfy the requirements of the sheep. The growing of crops for early green feed is a procedure which might with advantage be more generally adopted as a precautionary measure. In any case, it is a sound farming practice which will later provide the rapidly growing lambs with an abundance of feed.

Exercise.—Almost all of those who have investigated the disease are agreed upon the beneficial effects of exercise. In order that this may be obtained, droving in some instances will be necessary, in which case the flock should be travelled slowly for a distance of about a mile daily. Hand-fed sheep will be compelled to take exercise if the feed is distributed in a different part of the paddock each day or if conditions are so arranged that it will be necessary for them to travel to water.

Periods of sudden starvation during late pregnancy, such as would result from trucking or yarding for unduly long periods, should be avoided.

MEASURES NECESSARY TO CONTROL AN OUTBREAK

When an outbreak of pregnancy toxaemia occurs, the application of the preventive measures detailed above will be necessary in order to check the mortality. In most, if not all outbreaks, evidence of under-nutrition will be found, and this must be corrected. Hand-feeding on the above recommended scale should be commenced immediately, or if the scale of feeding has been found inadequate it should be increase to at least that level. Better still, the flock should be turned on to a young green crop if this is available. Daily exercise should be combined with these measures.

FOOTROT IN SHEEP

Quarantine Regulations Ignored

ON several occasions recently, sheep from properties in quarantine for footrot have been forwarded for sale without reference to the Department.

The removal of sheep from a property in quarantine and their subsequent sale by auction to other graziers whose flocks are free of the disease is a serious offence for which a heavy penalty has been prescribed under the Stock Diseases Act regulations. Flock owners are warned that it will become necessary to take legal proceedings should this practice be continued.

When any property is found to be affected by footrot, quarantine restrictions are imposed as a precaution against the further spread of the disease to other properties and this quarantine is maintained until the flock has been freed of the infection.

Permits for the sale of sheep for the purpose of immediate slaughter at Midland Junction from properties affected by footrot, may be obtained upon application to the Department either direct or through any of the livestock agents.

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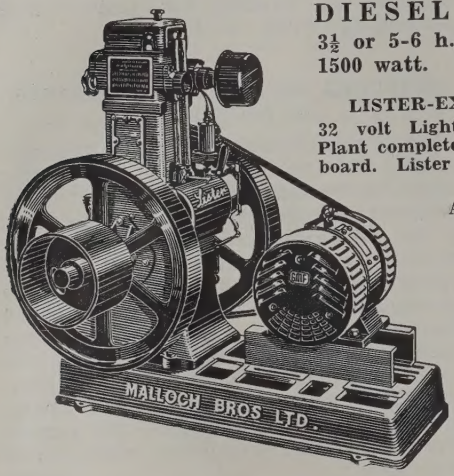

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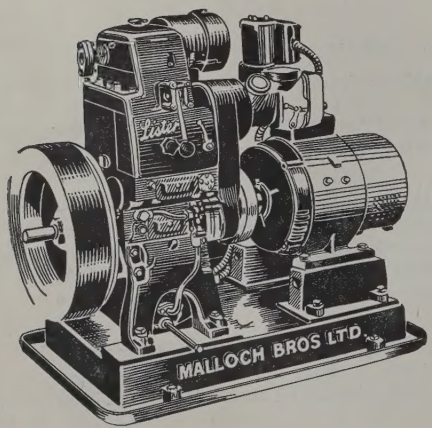

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